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UTILIZATION OF BIOLOGIC PRINCIPLES IN THE PRACTICE OF OPERATIVE DENTISTRY

II. Statistics, an Aid to Efficient Diagnosis[1]

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There is no subject of greater importance to dentists than that of diagnosis of carious lesions. The publications of Burket (1), Bodmer (2), and of Sognnaes (3) reveal the need for thorough systematic mouth examination. These authors have shown that no single method of examination, clinical or roentgenologic, is highly efficient. Burket's report of comparative gross, roentgenologic and microscopic examinations for dental caries in 460 teeth during routine necropsy studies indicates that cavities are detected by careful gross clinical examination more often than by the use of roentgenograms. The roentgen ray was most effective in determining interproximal caries. Clinical and roentgenologic examination failed to reveal the presence of 25 per cent of all cavities observed in serial microscopic preparations of the teeth studied. It is the consensus that best, but not perfect, results are obtained by a combination of gross clinical with roentgenologic examinations. Bite-wing films have been shown to be more accurate for interproximal lesions than regular intraoral films.

Statistical studies of cavity incidence by Cohen (4), Hyatt (5), Klein and Palmer (6), Leigh (7), and by McCall (8) are helpful to the practitioner in his search for signs of dental caries. The purpose of this study is to present an analysis of certain parts of these statistical studies that may be used to advantage by the dentist as a diagnostic aid during mouth examination. The use of this material with a systematic technic described in a previous publication (9) will improve examination efficiency.

Fig. 1 gives a comprehensive analysis of data published by McCall (8) dealing with the occurrence of carious lesions on each deciduous tooth surface of a group of 4,596 children from 2 to 6 years of age. The chart reveals that in a group of this age we may expect to find most of the cavities on the occlusal surfaces of the second deciduous molars. The mesial and distal surfaces of the maxillary deciduous first incisors, first and second molars and the occlusal surfaces of the first molars will be carious in 11 to 28 per cent of cases. One out of every 2 patients in this age range will have carious lesions or their consequences on occlusal surfaces of the second deciduous molars and 1 out of 5 will have cavities on those surfaces mentioned in the second grouping. If a cavity is found on a surface with a low cavity incidence, one may reasonably expect to find carious

[1] Received for publication December 21, 1941.

lesions on all those surfaces with a higher incidence. The remarkable bilaterality of cavities is evident even at this early age. This characteristic of the carious process is one of the practitioner's chief guides during mouth examination. The occurrence of a cavity on one side of the arch is an almost sure sign that one will be found on the opposite side in a similar position. This relation is so constant that the examiner should be doubly certain when a cavity is found on one side that its counterpart is not present on the other.

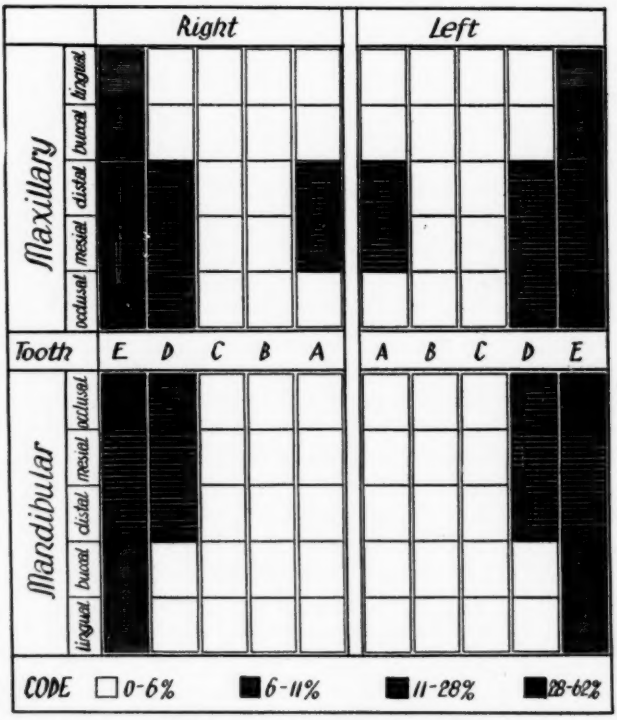

FIG. 1. Cavity incidence, deciduous teeth. 4596 pre-school children, age 2-6, adapted from J. Oppie McCall, 1938.

Figs. 2 and *3* are analyses of data published by Cohen (4). They reveal the ages at which cavities are most likely to occur in certain teeth. At the age of 4, 60 per cent of the second deciduous molars are attacked by caries in the average child. Cavities may be found in 50 per cent of the maxillary first permanent molars at 8 years of age. This data is useful to the dentist as a check on examination accuracy. A review of office records should reveal that 6 of every 10 deciduous second molars have been affected by dental caries in patients 4 years old. A comparison of office data with these charts will indicate whether cavities are found in the proportion predicted for an average group at a particular age.

Klein and Palmer's (6) studies of 4,416 grade school children, ages 6–15,

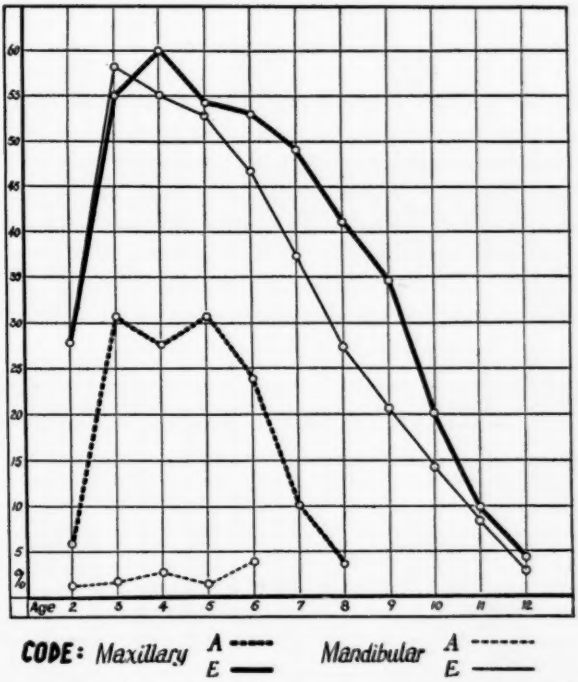

FIG. 2. Percentage of deciduous first incisors and second molars with cavities at different ages. Adapted from J. T. Cohen, 1936.

FIG. 3. Percentage of permanent first incisors and first molars with cavities at different ages. Adapted from J. T. Cohen, 1936.

show an average of nearly 5.5 carious permanent tooth surfaces per child. They have estimated that there will be an increase of approximately 1.3 new carious surfaces per year in the average child. The greatest number, 3.6 new carious surfaces, is found between 14 and 15 while the least, .32 new carious surfaces, occurs between 10 and 11 years. The clinical application of this data lies in its use as an index of caries activity. It also serves as a rough check on examination accuracy. We may expect patients of corresponding ages to develop approximately as many new cavities per year as those studied by Klein and Palmer (6).

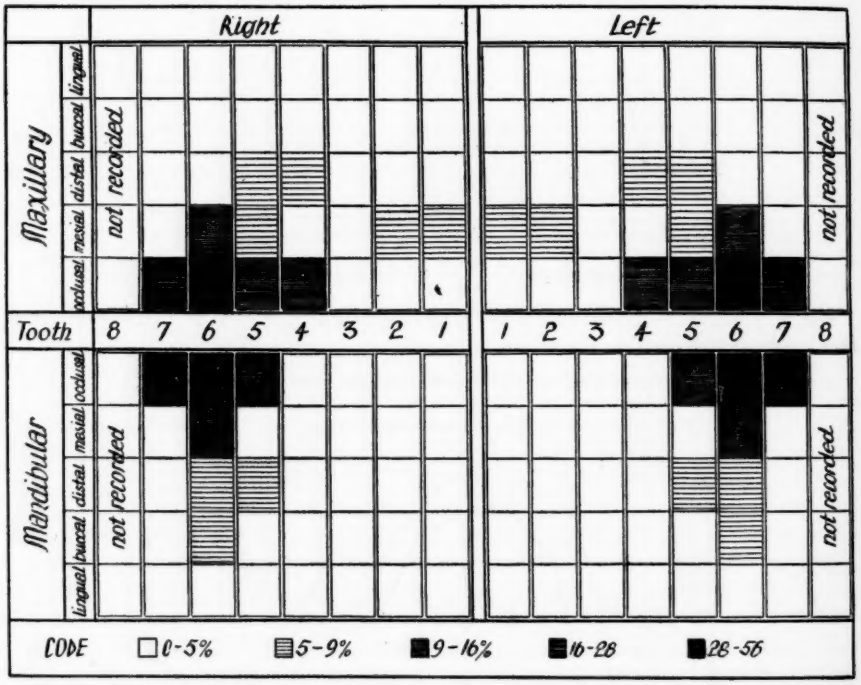

FIG. 4. Cavity incidence permanent teeth. 7942 young men age 17–24. Adapted from R. W. Leigh, 1924.

Fig. 4 is an adaptation of Leigh's (7) observations of 7,942 men, 17–24 years of age. It is included to demonstrate that results obtained by slightly different methods in widely separated parts of the country differ slightly. This difference is so small that it has little clinical significance. This chart may be compared with *fig. 5*, another analysis of a similar age group.

Figs. 5, 6 and *7* are derived from data published by Hyatt (5). They reveal the changes in cavity incidence with advance in age. In general those surfaces not attacked in the younger groups have an increase in cavities with advancing age. The increase seen on the buccal surfaces of canines and premolars is a valuable clinical guide during examination of elderly patients. Bilaterality of

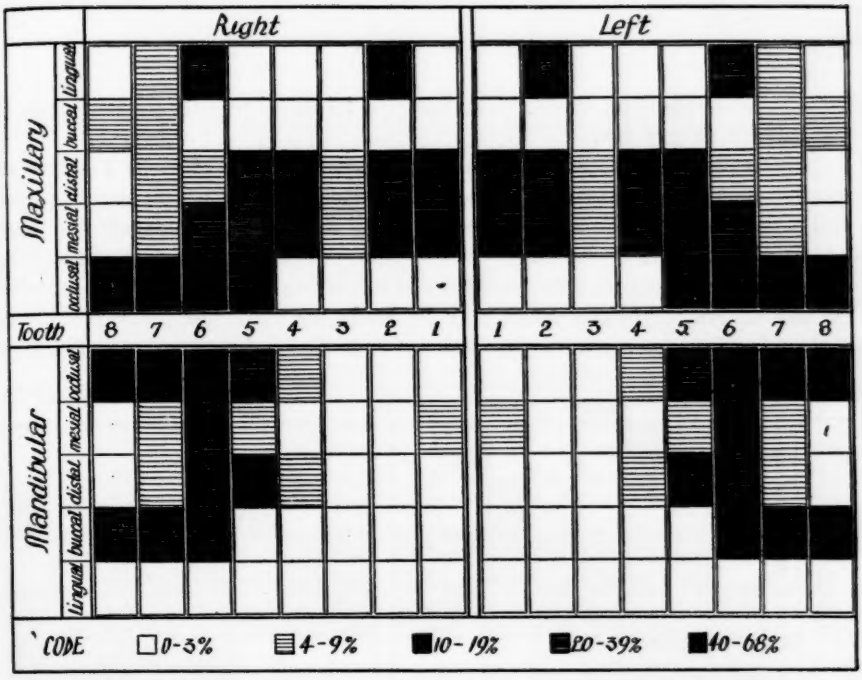

FIG. 5. Cavity incidence permanent teeth. 10,071 patients age 16–29. Adapted from T. P. Hyatt, 1940.

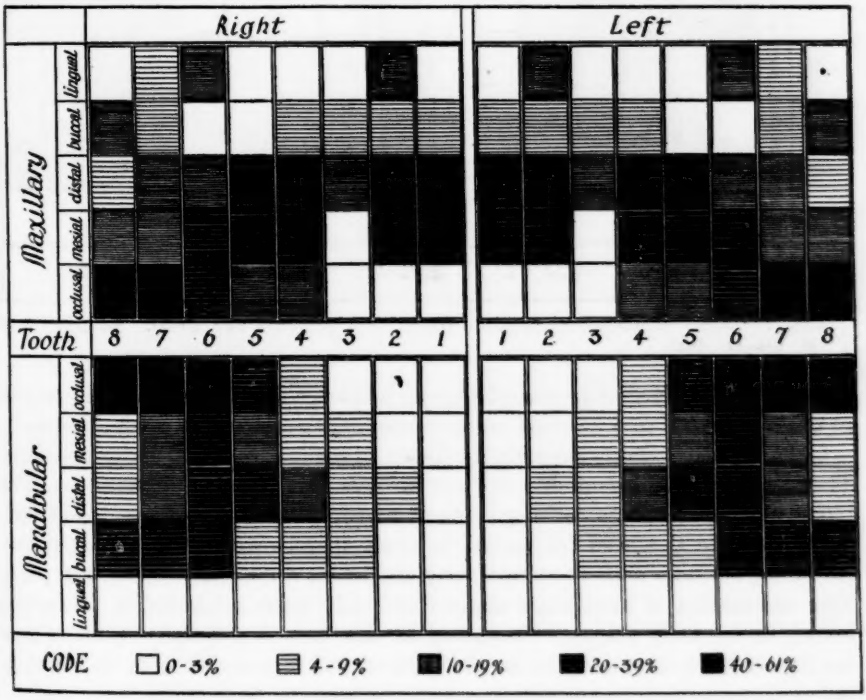

FIG. 6. Cavity incidence permanent teeth. 1780 patients age 30–44. Adapted from T. P. Hyatt, 1940.

lesions diminishes from 45–59. This factor is too small to alter the usefulness of the concept at any age.

Lesions occur most frequently on the occlusal surfaces of molar teeth in all groups, 16–59 years of age. The mesial and distal surfaces of the maxillary first and second incisors are attacked consistently and in approximately the same ratio as other surfaces indicated by the same design in the charts. Grouping of surfaces according to cavity incidence is a practical guide. Master charts for permanent and deciduous teeth may be made for office use. Those areas of highest incidence are colored brilliant red to indicate dangerous susceptibility.

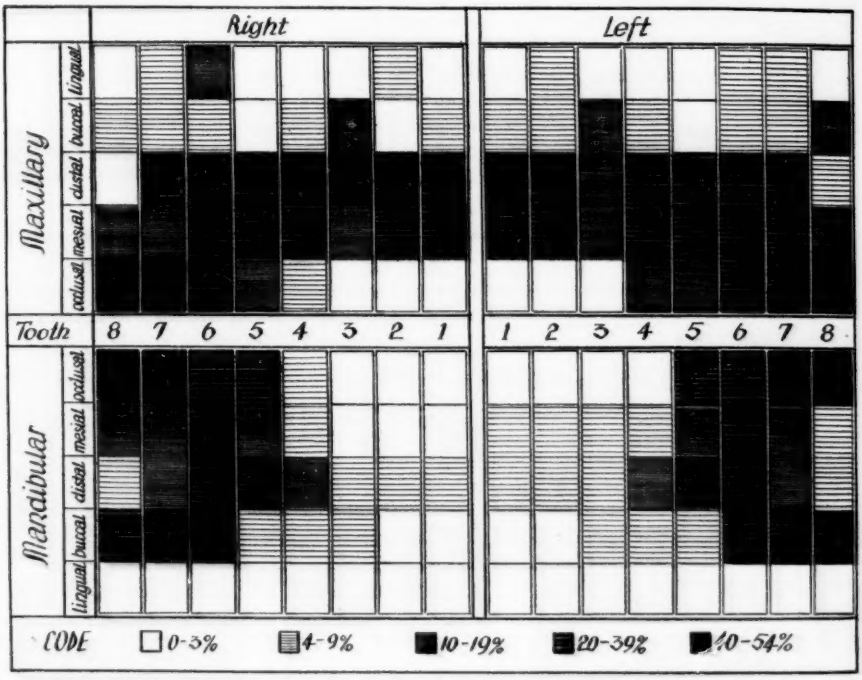

FIG. 7. Cavity incidence permanent teeth. 794 patients age 45–59. Adapted from T. P. Hyatt, 1940.

The group of surfaces with second highest incidence may be colored orange, and so on. This plan may be used on most examination charts in common use.

Colored master charts simplify the data and make it easier to use in the office. They act as constant reminders of those surfaces that are apt to be carious. The bilaterality of lesions is constantly emphasized. Cavities in areas of low incidence indicate the need for careful scrutiny in all areas of higher incidence. Adjoining surfaces with identical cavity incidences are usually affected in pairs. This summation of knowledge applied clinically leads to detection of carious lesions in the early stages. Treatment at this time is a health service of preventive character, economical to the patient and remunerative to the dentist.

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ENAMEL OF SHARK'S TEETH[1]

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There is an old controversy among histologists concerning the outer layer of shark's teeth; some claiming that it is enamel, others that it is dentin. A good case can be made out for either side, if the microscope alone is used. But before deciding this question it is necessary that a broad picture be drawn of the process of enamel and dentin formation and calcification, including the paleontologist's idea of gradual tissue specialization.

Richard Owen (4), was particularly interested in observing the same organ in different animals under every variety of form and function. He first used the terms, homology and analogy. In his monumental work on dental forms in vertebrates he wrote:

> "We have seen, for example, that the dentine is scarcely distinguishable from the tissue of the skeleton in the majority of fishes: but that its peculiarly dense, unvascular and resisting structure which is the exceptional condition in fishes, is its prevalent character in the teeth of the higher vertebrates.
>
> "So likewise with the enamel; this substance which under all its conditions bears a close analogy with the dentine, is hardly distinguishable from that tissue in the teeth of many fishes."

But Owen did not see the difference between marsupial and human enamel. The elder Tomes (8) observed that dentinal tubules are continued into and constitute a considerable portion of the enamel in marsupials but in human teeth the dentinal tubules only occasionally are continued for a short distance into the enamel as spindles.

C. S. Tomes (10) noted that the enamels of plagiostome fish, osseous fish, marsupials and placental mammals present resemblances which are far stronger than their differences, but the formative process is by no means identical. He inferred that these differences may represent stages in the evolution of enamel; and divided enamels into groups based upon the method of development: A. Enamel which is not wholly epiblastic in origin. Seen in plagiostome fishes. Matrix is formed from mesoderm although ameloblasts have some part. B. Enamels wholly epiblastic in origin. 1. Ameloblasts lose their integrity and are transformed into a stroma of full dimension of ultimate enamel. In this stroma 'calcification' goes on proceeding outward from dentin surface. Seen in Gadidae, Labrus and Sargus. 2. Ameloblasts persist and retain their character throughout the whole period of enamel formation and are not transformed into an enamel stroma. Their free ends are continued into processes which,

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while enamel formation is going on, can be traced through great part of its thickness, i.e., Marsupials. 3. Ameloblasts persist and free ends have short processes which dip a little way into young enamel; the full 'calcification' follows very close upon the heels of any alteration of the ameloblasts, so that there is only a very narrow zone between the unaltered ameloblast cell and perfect enamel (matrix), i.e., Placental mammals. While these methods do not present a graded series, they seem to indicate an increasing specialization in the ameloblast cells and an increasing importance in the part played by them.

The initial evolutionary appearance of a true enamel organ in vertebrates was demonstrated by Hertwig (3) in the development of the placoid scales or dermal spines of modern sharks. The work of Hertwig also demonstrated the homology between teeth and placoid scales. As Tomes (9) observed, there is, in the teeth of plagiostome fish, "a plain ocular demonstration that the teeth are merely modified dermal spines, so that they exemplify the first appearance of true teeth amongst the vertebrates."

Rose (6) and other histologists assumed the outer layer of a shark's tooth to be a form of dentin. The most recent paper on the subject (Schmidt, 7) reopens the question. Schmidt considered that he had found a new type of dentin on the crown of shark's teeth, claiming that they have no enamel. He stated that the porcelain-like layer formerly believed to be enamel covering the tooth crown, is really dentin from which the collagen disappeared and in which the content of calcium salts is increased by formation of needle-like elements. This "duro-dentin" is formed from normal calcified dentin. The transformation progresses from the periphery to the interior of the tooth. This porcelain-like zone is calcified from outside to inside and therefore Schmidt concluded that calcium does not come from the ameloblasts but from fibers of Tomes' of the odontoblasts. Tomes (9) pointed out, however, that more complete calcification has still to go on even after the dentin cap is beginning to cut off the dentin pulp from the outer layer.

Schmidt also stated that during development, the luster appears gradually and progresses from the tip of the tooth to its base, beginning at the edge or surface. While Schmidt offered this description in support of the idea that he was describing dentin calcification, it may also be interpreted in the light of Diamond and Weinmann's (1) study as calcification of an "enamel" matrix. Enamel calcification does not begin at the dentino-enamel junction and proceed outward parallel to the direction of the incremental lines. It begins at cuspal eminences and proceeds in a transverse relation to the incremental lines toward the cervix of the tooth. This direction of calcification may be correlated with "appearance of luster" on the shark's tooth progressing from tip of tooth to its base.

MATERIALS AND FINDINGS

Ground and decalcified sections were prepared from typical shark's teeth and their cartilaginous jaws. Radiographs were taken of longitudinal blocks of the shark's teeth and jaws (Man-eater and Sand shark) before decalcification.

Grenz-ray pictures were also made of ground sections of individual teeth at various stages of development.

A decalcified, hematoxylin and eosin stained, longitudinal section of a shark's jaw (Man-eater, *Carcharodon carcharias*) and teeth is seen in *fig. 1*. The teeth are arranged serially in rows lying one behind the other and developing progressively from within to the surface of the jaw. In this section 1 active or erupted tooth and 6 reserve, unerupted teeth are seen. There is a graded series of development from youngest, unerupted tooth germ to the oldest, completely mature, erupted tooth. These teeth form in a fold of mucous membrane on the lingual side of the jaw.

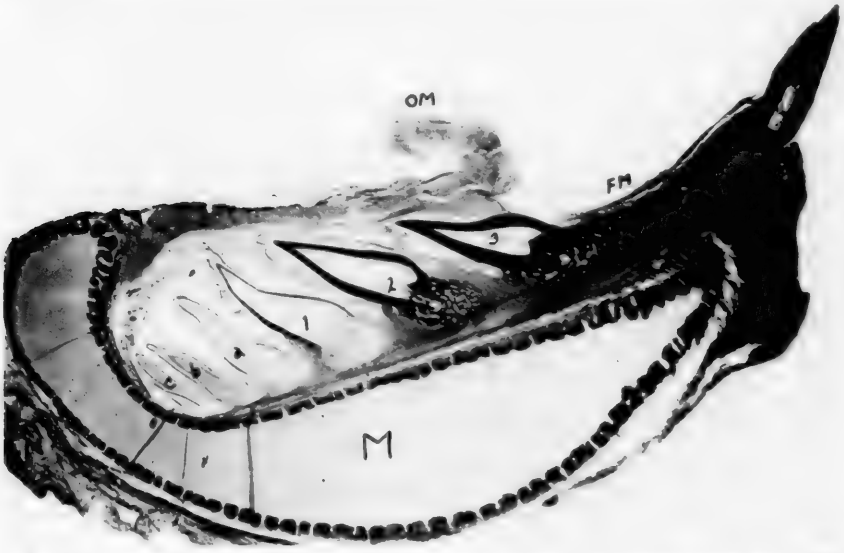

FIG. 1. Longitudinal decalcified section of a shark's jaw. M—cartilaginous jaw. OM—fold of oral mucosa on lingual side of jaw covering unerupted teeth. FM—fibrous membrane attaching teeth to jaw (bone at apex of each tooth is like cementum on human teeth). c, b, and a—young teeth with enamel matrix only. 1, 2, 3, and 4—older teeth with increasing thickness of dentin. Orig. mag. 15 ×

That the epithelial ingrowth or dental lamina gives off buds for the row of teeth is evident in *fig. 1*. The primitive dental lamina in the shark is merely a rolled-up fold of skin bearing dermoid denticles (2). In the youngest unerupted tooth germs, a, b, and c, a "fibrous" network is formed between the odontoblasts and ameloblasts, which is seen under higher magnification in *fig. 2*. The pink staining enamel matrix is seen at the tip of the forming tooth between ameloblasts, 'A,' and odontoblasts, 'O.' In later stages, like the keratin of human enamel matrix, it stains blue in hematoxylin and eosin.

Tomes (9) admitted that the enamel matrix is a product of the odontoblasts and also observed the tremendous changes of the ameloblasts, i.e., increase and

decrease in size and change in staining reaction, which is seen in *figs. 2* and *3*. On this evidence Tomes felt that the ameloblasts must have some function in the calcification of the enamel. The change in staining reaction of the enamel matrix is doubtless related to the deposition of calcospherites by the ameloblasts such as described by Williams (5) in the secretion of human enamel matrix (*fig. 8*).

In the older tooth germs, 1, 2, 3 and 4 of *fig. 1*, the dentin matrix stains red. The oldest unerupted shark tooth of this series is shown, enlarged, in *fig. 3*. The deeply stained dentin has thread-like extensions into the delicate enamel matrix. Because these threads or fibers are said to be tubes Rose's considered the outer layer of the shark's tooth to be dentin. Tomes pointed out that similar tubes are found in marsupial enamel. Furthermore, these tubes do not remain open permanently and their contents are more like calcified Sharpey's fibers. The enamel spindles of human teeth may be a vestige of this pattern.

It is interesting to compare ground sections of the oldest, functional and erupted tooth and a younger unerupted tooth of the "Man-eater" shark. Both of these teeth are the same size peripherally and we conclude that the inner dentin must be laid down at the expense of the pulp tissue which recedes in the mature form.

Tomes did not study the x-ray density of shark's enamel. Rose claimed it was not as hard as most enamels, but the grenz-ray picture of these 2 ground sections taken simultaneously (fig. 4), shows that the outer layer of enamel is the same density in both teeth and about twice the density of the inner dentin. This is similar to the density ratio of human dentin and enamel as evidenced by comparison with an aluminum wedge or penetrometer. Shark enamel, as determined by the penetrometer method, is twice as dense as shark dentin, the same as the relationship between these tissues in human teeth.

One can correlate the gradual appearance of "luster" on the teeth of the Sand shark (*Carcharias littoralis*) with an increase of radiopacity. Thus in *fig. 5a*, a longitudinal block cut from the shark's lower jaw, the 6 largest and most lustrous teeth are also radiopaque in the x-ray picture, *fig. 5b*. The 5 younger unerupted teeth all lack luster and are so radiolucent that they do not even register in on the x-ray film. In these younger unerupted teeth the enamel is still either in the matrix state or not yet formed. Note also that the placoid scales on the surface of the jaw are as radiopaque, or nearly as radiopaque, as the teeth. This block was cut out with only 1 row of teeth to avoid unnecessary superimposition in the x-ray picture.

In this species of shark, enamel and dentin of individual teeth are superimposed and this causes greatly increased density of the larger and older teeth. The enamel starts to calcify at the periphery, beginning at the tip of the tooth. It gradually increases in density as well as in size just as does the osteodentin in the pulp chamber. The direction of calcification of the outer layer follows Diamond and Weinmann's concept of enamel calcification.

Fig. 6 shows a ground section of an erupted tooth of the Sand shark. Schmidt claims that there is no enamel, and calls the whole outer layer (A and B), duro-

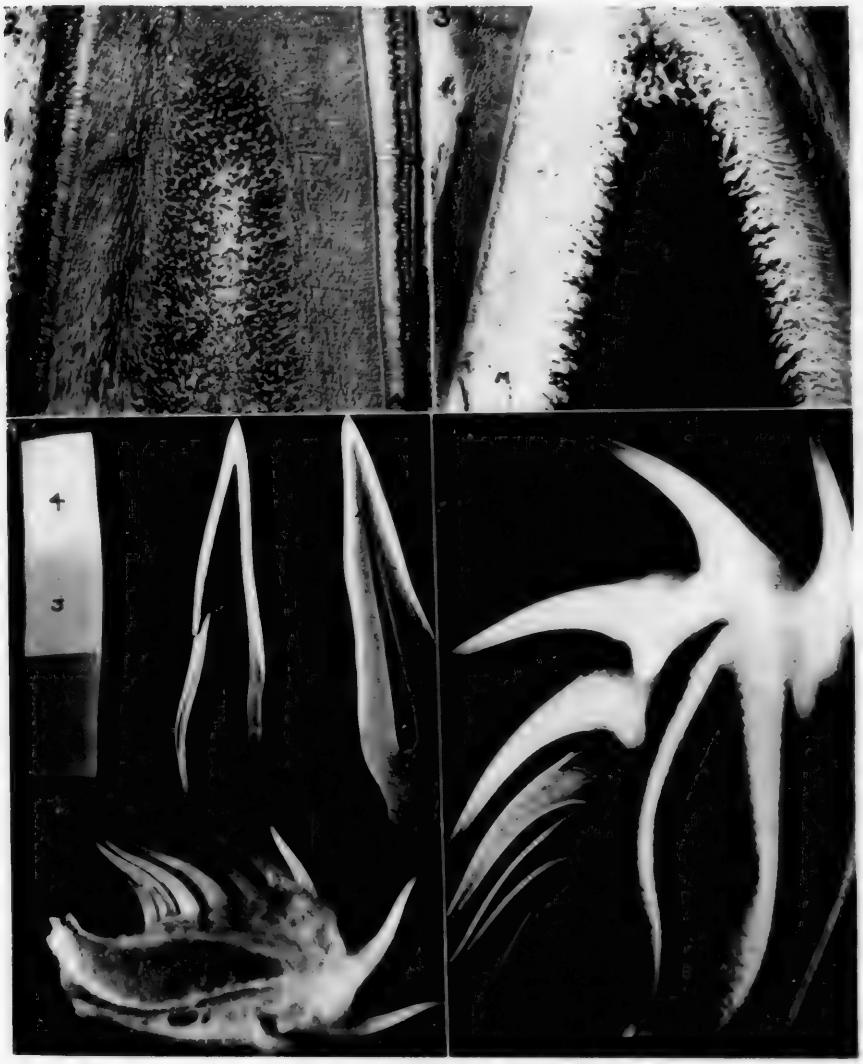

FIG. 2. Photomicrograph of tip of youngest tooth, 'c', in *fig. 1*. Note large, clear ameloblasts, 'A', and odontoblasts, 'O'. This "enamel" matrix is product of mesoderm and forms before dentin. Orig. mag. 150 ×

FIG. 3. Photomicrograph of tip of oldest unerupted tooth 3 of *fig. 1*. Note smaller size of ameloblasts, 'A', and change in staining. Enamel matrix, 'M', stains blue, and dentin matrix, 'D', stains red. Orig. mag. 150 ×

FIG. 4. Grenz-ray picture of 2 ground sections. This picture shows by comparison with penetrometer (grey scale) that outer layer of tooth is twice as dense as inner dentin. Note increase in amount of dentin and bone in older tooth. 15 ×

FIG. 5a. Photograph of longitudinal block cut from Sand shark's lower jaw. Gradual appearance of luster can be correlated with density in x-ray picture, *fig. 5b*.

FIG. 5b. X-ray picture of block of teeth seen in *fig. 5a*. Note gradual increase in radiopacity of series of teeth from bottom to top. Five bottom teeth, youngest in series, do not register on the x-ray film. Note gradual filling-in of the pulp chamber with osteo-dentin as teeth mature. 15 ×

dentin, but divides it into (outer) positive and (inner) negative zones by polarized light. He calls the tissue in the pulp chamber (C) trabeculo-dentin. Tomes calls "A" enamel, "B" dentin, and "C" osteodentine.

Grenz-ray pictures were taken of this section with variation of exposure time to study density first in the outer layer and also in the inner tissue. In *fig. 7a*, the difference in density between the outer layer of the tooth and the osteo-dentin is apparent. By overexposing the osteodentin in *fig. 7b*, the difference in density and tubularity between what Schmidt calls zones of duro-dentin can be seen. Such differences warrant the use of the terms enamel, dentin and

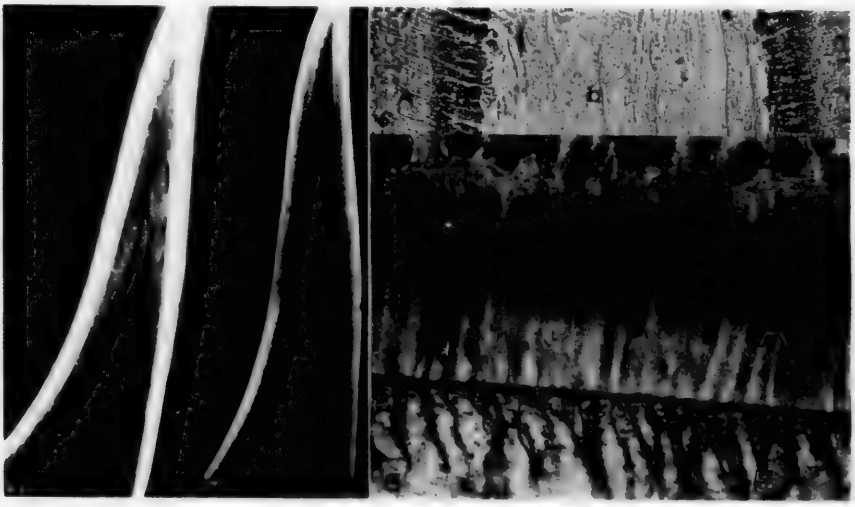

FIG. 6. Photomicrograph of area near tip of erupted tooth of a Sand shark. Schmidt calls outer layer, duro-dentin, but divides it into positive, 'A', and negative, 'B', zones, and calls 'C', trabeculodentin. Tomes calls 'A' enamel, 'B' dentin, and 'C' osteo-dentin. 15 ×

FIGS. 7a and 7b. Grenz-ray pictures of ground section seen in *fig. 6*. 7a, shows difference in density between outer layer of tooth and osteo-dentin. 7b, shows difference in density and tubularity between enamel and dentin in surface layer of tooth. 20 ×

FIG. 8. Photomicrograph of ameloblasts, 'A', and enamel matrix, 'E', from decalcified section of tooth of Sand shark. Calcospherites are being secreted by ameloblasts into enamel matrix. Orig. mag. 1100 ×

osteo-dentin as employed by Tomes. The histogenesis of the outer zone warrants the term enamel. Study of the decalcified sections of this Sand shark discloses conditions in the enamel matrix similar to those of the Man-eater shark (*figs. 2* and *3*). Similar changes in size and staining of the ameloblasts are seen. *Fig. 8* illustrates a functional state of the ameloblasts intermediate between that shown in *figs. 2* and *3*. This is an enlargement of the sixth tooth in the series shown in *fig. 5a*. Minute refractive bodies are seen in the ameloblasts, 'A', which are secreted by them into the enamel matrix, 'E'. These globules are probably part of the calcific material, since the tooth, where the process is going on, is also the first tooth to be radiopaque (*fig. 5b*).

SUMMARY

1. Tomes noted that enamels of plagiostome fish, osseous fish, marsupials and placental mammals present resemblances which are far stronger than their differences. 2. In sharks there is an enamel organ formed from ectoderm, as in mammalian enamel formation. The ameloblasts are concerned in calcification of the matrix. 3. In studying the teeth of sharks the 2 tissues on the teeth, dentin and enamel, which are homologous with the tissues of other vertebrate teeth, are seen. 4. Radiographs of shark teeth show that there is a marked difference of density of the 2 tissues, entirely comparable to mammalian teeth. 5. The direction of calcification of shark's enamel is somewhat like the pattern of human enamel as described by Diamond and Weinmann and is correlated with the appearance of luster on the surface, which progresses from tip of tooth to its base. 6. In microscopic examination of a thin ground section marked differences in the morphologic appearance of the 2 tissues and a sharp line of demarcation at the dentino-enamel junction due to difference in refractive index of the tissues are seen. 7. In decalcified sections the dentin matrix has numerous projections into the enamel, but the enamel matrix stains differently from the dentin matrix. The delicate strands projecting into the enamel matrix are definitely related to the dentin matrix, but this is also seen in marsupial enamel. The spindles of human enamel are vestigial. 8. The evidence from paleontology indicates that shark's teeth are the forerunners of the teeth of modern vertebrates. Thus, from a consideration of all the evidence we conclude that the outer layer covering the teeth of the shark is a form of enamel.

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RELATIONSHIP OF DENTAL CARIES TO DEFICIENCIES OF THE VITAMIN B GROUP[1]

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Unpublished observations by Mann (1940) revealed a low incidence of dental caries among patients attending the Nutrition Clinic of Hillman Hospital in Birmingham, Alabama. The association of large numbers of oral strains of lactobacilli with active caries is probably aided by favorable environmental conditions, especially adequate nutrition for bacterial growth. Pantothenic acid has been reported as present in the saliva, and is a nutritional requirement for lactobacilli isolated from the mouth (2). Since the blood of patients with pellagra, beriberi and riboflavin deficiency has shown a decreased pantothenic acid content of from 23 to 50 per cent below the normal average (1), it became desirable to determine the salivary pantothenic acid values of such patients, and the ability of their salivas to support oral lactobacilli growth, as evidenced by salivary lactobacillus counts.

SELECTION OF PATIENTS AND METHOD OF STUDY

A series of 51 patients was selected on an age basis. Patients between the ages of 4 and 20 years, inclusive, who came to the Nutrition Clinic of Hillman Hospital, with or without evidence of active clinical deficiency diseases, were examined. Four patients were under treatment for their nutritional deficiencies at the time the study was made. Others had received treatment in previous years or were treated after the study was completed.

These patients were repeatedly examined at frequent intervals by several members of the staff. Physical examinations and dietary histories emphasized the mixed nature of their vitamin deficiencies. Briefly, a tentative diagnosis of pellagra was made with evidence of characteristic dermatitis or the characteristic lesions of the oral mucous membranes, or both. The criteria for diagnosis of riboflavin deficiency were oral manifestations and angular cheilosis or ocular changes. Evidence of peripheral neuritis indicated thiamin deficiency.

Examinations of the teeth were made with a mirror and exploring tine, supplemented by a further check for incipient proximal decay with bite-wing radiographs of the posterior teeth.

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[2] William John Gies Fellow of the American College of Dentists.

Saliva to be tested was obtained by chewing paraffin. The method used in making quantitative lactobacillus estimations was that described by Hadley (3). The tomato juice agar medium used was a modification of Kulp's formula (4). Two or more samples of saliva were collected on different days and average counts reported. The pantothenic acid values were determined from the same salivary specimens (5).

Fluorine determinations were made by Margaret Lawrenz Swain on both spring and well waters used by these patients. The fluorine concentration of 8 specimens was found to range from 0.027 to 0.097 p.p.m., with an average of 0.049 p.p.m.

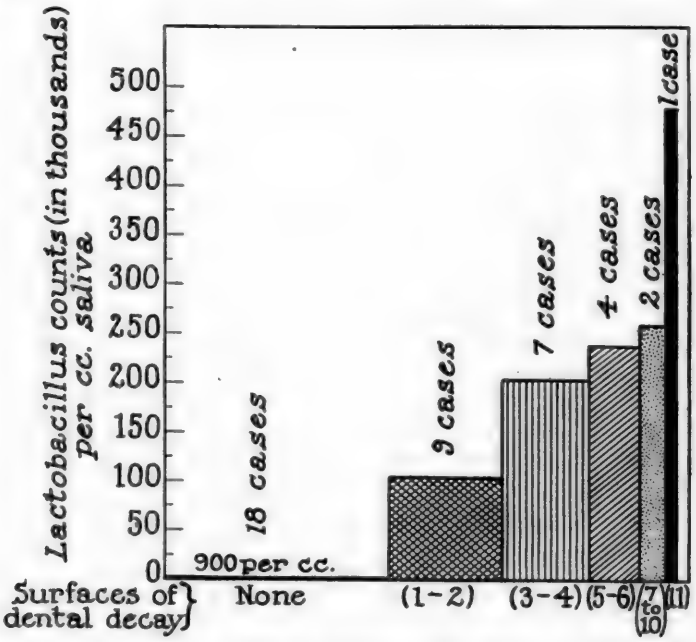

FIG. 1. Average lactobacillus counts of patients with clinical symptoms of vitamin B complex deficiencies.

CLINICAL OBSERVATIONS AND LACTOBACILLUS COUNTS

Clinical and radiographic findings showed no dental caries or restorations in 18 patients (35.3 per cent). Of these 18, all had zero lactobacillus counts except 4, which were low, i.e., below 30,000 per cc. of saliva. Of 6 patients, each of whom had 1 surface of a tooth questionably carious, 4 had zero lactobacillus counts. Three of 5 patients with 2 surfaces questionably involved had counts below 2,000, or negligible counts. Nevertheless, all doubtful areas of decay are included among the carious teeth.

Paralleling an increase in the number of cavities, the lactobacillus counts rose to 840,000. *Fig.* 1 illustrates the relationship between the number of

cavities and the average lactobacillus counts for such groupings. A zero count was obtained in 1 case which had 5 carious teeth. Dental caries was similar to that found in early life, i.e., largely pit and fissure cavities. Of 36 patients with their permanent incisors erupted, only 1 had anterior proximal cavities. This patient had 4 anterior cavities, and had no clinical symptoms of dietary deficiency at the time of examination.

Thirty-one patients showing clinical signs of pellagra, averaged 1.9 cavities per mouth with no restorations. Another group of 10 patients, which showed clinical signs of thiamin and riboflavin deficiencies, averaged 2.9 cavities per mouth with no restorations. Thus 41 patients with symptoms of a recognizable deficiency disease, averaged 2.1 cavities per mouth. Ten patients without clinical symptoms of a dietary deficiency visited this clinic. These averaged 6.1 cavities per mouth, including 10 restorations found in 2 patients.

Oral hygiene in all patients was extremely poor. Soft and hard deposits on the unclean areas of teeth were commonly observed. Few patients used a tooth brush or any other means of cleaning their teeth. No correlation of freedom from decay of the teeth and oral cleanliness is justifiable in this series. Tooth form and arch form were usually very good. Not one case of extreme malocclusion was noted in this study.

Little difficulty was experienced in collecting salivary samples for the lactobacillus counts and the pantothenic acid determinations. The salivary secretion was generally abundant and the rate of secretion was above average, especially in those patients with cheilosis at the angles of the mouth, or with evidence of a previous riboflavin deficiency or pellagrous glossitis.

Information concerning dietary habits was obtained from the patient or the patient's family. The diets were largely carbohydrate. Corn bread, salt pork, grits, beans, syrups and jams were their staple foods. Meats, milk, eggs, fruits and vegetables were either sparingly used or absent from the diet. It was of special note that in the high percentage of carbohydrate food consumed, much was in the form of simple sugars, some of which were usually eaten every day.

PANTOTHENIC ACID VALUES

Pantothenic acid was present in all salivas tested. Determinations ranged from 0.012 to 0.19 micrograms per cc. of saliva. Four patients who had treatment for their deficiencies during the study showed no change in the pantothenic acid content of their salivas. The salivary pantothenic acid values of 29 patients with lactobacillus counts below 13,000 per cc. averaged 0.0880 micrograms per cc. of saliva, while 22 patients with counts above 30,000 averaged 0.0885 micrograms per cc. of saliva.

SUMMARY AND CONCLUSIONS

1. Forty-one selected patients with evidence of pellagra, beriberi, and riboflavin deficiency, or some mixture of deficiency diseases as found by repeated examinations, had a low incidence of dental caries and correspondingly low

numbers of oral lactobacilli. 2. Using the lactobacillus count as an index of caries activity, no appreciable difference was observed in the pantothenic acid content of the salivas from patients resistant or susceptible to dental caries. 3. In all cases, pantothenic acid was present in a sufficiently high enough concentration for growth of oral lactobacilli. 4. These patients have a low incidence of dental caries irrespective of poor oral hygiene, accumulations upon the teeth, and a high carbohydrate diet usually in the form of simple sugars. 5. There was no evidence of fluorine in a concentration which could significantly effect a lowered incidence of dental caries.

Acknowledgment is made to Monette Springer, Nurse, for her aid, and to Sue Stanbery Sanders for determining the pantothenic acid values of saliva.

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ACIDOGENIC PROPERTIES OF CERTAIN ORAL MICROORGANISMS[1]

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INTRODUCTION

Marked differences of opinion as to the actual significance of microorganisms in dental caries are found in the literature. Dental caries, as it is well known, involves essentially the dissolution and disintegration of the enamel and dentin. This is generally believed to be caused by the action of "acid-producing bacteria" and their products. Many attempts have been made to isolate a specific organism responsible for decay but reports have only been conflicting. No one type of "acid-producing bacteria" has yet been shown to be responsible for the carious lesion. Perhaps Miller (1) is owed considerable more credit for maintaining that the initial lesion could be produced by any of a number of different organisms. Hartzell and Henrici (2) found oral streptococci of the "viridans" type to occur almost constantly in carious teeth, believing that they played the chief rôle in caries. Anderson and Rettger (3) also observed a high incidence of oral streptococci, and regarded them as possible important factors in dental decay. Clarke (4) believed that the carious lesion was produced by a new strain, *Streptococcus mutans*. Tunnicliff and Hammond (5) maintained that the rough phase of *Streptococcus viridans* was the invading organism.

An intensive study of the possible relation of *Lactobacillus acidophilus* to dental caries has been made by Bunting and co-workers (6, 7, 8, 9). They have concluded that dental caries is a specific bacterial disease and that *L. acidophilus* is the chief etiologic agency. The work of McIntosh, James, and Lazarus-Barlow (10), and Rodriguez (11) agreed with that of the Michigan group. Enright, Friesell and Trescher (12) observed that "the only microorganism commonly found in the food debris, in direct contact with progressive caries of the enamel, that can tolerate and produce additional acid in an environment below pH 5.0 is a lactobacillus". Tucker (13) claimed, however, that it was unusual to obtain *L. acidophilus* in pure culture from scrapings of teeth. Aciduric streptococci were found to be almost as acidogenic as *L. acidophilus*. Isolating palisaded rods, streptococci and staphylococci from casein digest sodium oleate agar that was streaked with glucose-beef infusion broth cultures from tooth scrapings, Tucker inoculated fresh broth to determine, colorimetrically, the pH values after 2–3 days incubation. Cultures containing the rods generally ranged in pH from 3.6 to 4.2, while cultures of streptococci and staphy-

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lococci ranged from pH 4 to 4.6. Tucker concluded that *L. acidophilus* apparently is not an "obligate producer" of dental decay. Hadley, Bunting and Delves (9) found that their Group I strains of oral aciduric rods produced an average acidity of pH 3.8 when incubated in glucose infusion broth for seven days, while strains of Groups II and III lowered the pH to 4.1. Snyder and Teachout (14) in a study of acid production by certain oral bacteria observed that none of the strains of streptococci isolated was able to produce any acid, while 9 of 60 strains of staphylococci produced significant quantities. On the other hand, 28 of 30 strains of lactobacilli formed large amounts of acid. They employed a colorimetric method in the investigation, determining the rate of acid production in brom cresol green-glucose agar (pH 5.0).

In a recent bacteriological investigation of a large group of both carious and non-carious individuals, study was made of the acidogenic properties of various microorganisms isolated from mouths exhibiting all degrees of caries activity. In an endeavor to throw some light on the problem the results are herein presented.

EXPERIMENTAL

Source of Material: Cultures of oral aciduric microorganisms were isolated from the saliva of 237 individuals. Each individual was given a thorough dental examination and his case history recorded. Of the total number, 136 were carious and 101 were non-carious. The non-carious group included a number of absolute-immunes (with all teeth intact and no evidence of any lesions); individuals with previous extractions, but no existing cavities nor fillings; and finally, those with no open cavities, but with fillings. The carious group was made up of individuals showing all degrees of caries, ranging from incipient to rampant (10 or more open cavities).

Collection of Material: Saliva samples were obtained from each subject about 2 hours after breakfast. Stimulation of the flow of saliva was induced by chewing sterile paraffin, and approximately 25 cc. of saliva were collected from each subject into sterile sputum bottles.

Isolation of Cultures: Each sample of saliva was diluted with sterile water. Pour-plates were prepared in acid-agar, using the following dilutions: 1:10, 1:100, 1:1,000, 1:10,000; and 1 cc. of saliva direct. Plates were incubated at 37°C. for 5 days in an atmosphere of 10 per cent CO_2. The medium used for the isolation of various strains of oral aciduric microorganisms was essentially Kulp and White's (15) tomato juice peptonized milk peptone agar, with the modifications described by Hadley (16). The changes by Hadley included the use of 2 per cent agar instead of 1.1 per cent, and adjustment of the reaction to pH 5.0 instead of 6.2.

In preliminary work the tomato juice agar did not prove quite as specific for *L. acidophilus* as Hadley maintained, when saliva was streaked on this medium. Streptococci, staphylococci and yeast appeared with constant regularity. This was taken advantage of, however, to facilitate isolation of the different aciduric types used in the study. Because of the capability of growth of types other

than lactobacilli on this medium, the gram-stain was employed to determine cell morphology. Because of possible discrepancies due to overgrowth of one organism by another, the "pour-plate" method was used, rather than streaking the surface of the agar with saliva. The former method also aided towards obtainment of pure strains.

Selection of Cultures: Gram-stains were made of representative colonies of each type capable of growth in the acid-tomato agar. Gram-positive, non-spore-forming rods appearing singly or in chains were regarded as lactobacilli.

Each colony was fished into tomato juice broth (pH 5.0), incubated for 48 hours at 37°C., and replated in the acid-agar to insure purity of strain. After Gram-staining the resulting colonies, they were then picked and inoculated into 1 per cent dextrose beef infusion broth of pH 6.6, and incubated for 48 hours at 37°C. Following incubation, Gram-stains were made of the broth cultures as a check on the stain prepared from the last plating. Two loopsful of each dextrose-beef broth culture were then inoculated into 15 cc. of 1 per cent dextrose beef infusion broth (pH 6.6) in triplicate and incubated at 37°C. At the end of 48 hours, 72 hours, and 1 week a tube of each culture was removed, and the pH determined by means of a glass electrode pH meter.

In the above manner the acidogenic powers of 242 cultures of aciduric microorganisms isolated from the saliva of various individuals were determined. Included were Gram-positive rods (lactobacilli), streptococci, staphylococci and yeast.

RESULTS AND DISCUSSION

It was apparent from data obtained that the source of the cultures bore no relation to the acidogenic properties exhibited by the respective strains. No correlation could be made between the degree of caries activity in individuals and the extent of acid production by microorganisms from which individuals they were correspondingly isolated.

Of 121 strains of the smooth (S) form of lactobacilli examined, 77 produced a pH ranging from 4.0 to 3.6 in glucose broth after 7 days incubation. The remaining 44 strains produced an acidity between pH 4.9 and 4.1. None of 14 strains of the rough (R) form of lactobacilli, isolated from saliva, was capable of reducing the pH of the glucose broth below 5.25.

Thirty-nine of 68 strains of streptococci tested produced a pH ranging from 4.0 to 3.4. Of 25 strains of staphylococci, 10 were capable of producing an acidity between pH 4.0 and 3.7.

The acidogenic powers of oral yeast in glucose broth were comparatively slight. The lowest pH produced by any of the 14 yeasts tested was 5.17.

The results indicated that oral streptococci and staphylococci may produce as much acid as lactobacilli. Some strains of streptococci were capable of even greater acid production than either lactobacilli or staphylococci. The lowest pH value obtained in glucose broth cultures containing lactobacilli was 3.6; for cultures of staphylococci the lowest value was 3.7, while some strains of streptococci reduced the pH to 3.4. A summary of the results is given in Table I.

The values for streptococci and staphylococci were much lower than those obtained by Tucker (13), but results with lactobacilli were in agreement with those reported by Tucker, and by Enright, Friesell and Trescher (12). It is worthy to note that the acidogenic power of the R form of lactobacilli was low as compared to that of the S form. Hadley, Bunting and Delves (9) likewise found that their S forms (Group I) produced more acid then the R forms (Group III). If such data is of any significance in the etiology of dental caries, it then becomes not so much a problem of the mere presence of bacteria but rather of the types. The R form of oral lactobacilli not only produces much less acid than the S form but also grows more slowly.

None of the strains of streptococci studied by Snyder and Teachout (14) was found to be acidogenic. The incorporation of various dyes in media, as employed by a number of workers, for the purpose of determining acid production

TABLE I

Summary of data obtained in determinations of acidogenic properties of oral microorganisms

ORGANISM	NO. OF STRAINS	pH RANGE	AVERAGE pH
Lactobacilli	77 (smooth)	4.00–3.60	3.82
	44 (")	4.90–4.05	4.43
	13 (rough)	6.15–5.40	5.81
	1 (")	5.25	5.25
Streptococci	39	4.00–3.40	3.60
	20	4.75–4.10	4.40
	9	5.25–4.80	5.00
Staphylococci	10	4.00–3.73	3.89
	15	4.89–4.31	4.72
Yeast	4	5.50–5.17	5.33
	10	6.08–5.65	6.01

by microorganisms has its limitations. In a study of this type such a method could hardly be recommended.

Members of the Michigan group have concluded that lactobacilli are the chief factors in dental caries, furnishing the acid necessary for the decalcification process. This now classic theory is hardly reconcilable with the data presented above and with observations made by other workers (2, 3, 4, 5, 13).

COMMENT

Considering the acidogenic properties of certain oral lactobacilli, streptococci and staphylococci, it seems that any one type may, of itself, be the cause of enamel decalcification. Probably, they are all involved in the process. "In vitro" studies by the author[3] have shown that disintegration of tooth enamel may be brought about by oral aciduric streptococci as well as by lactobacilli.

[3] Unpublished data.

Proponents of the germ theory of dental caries have apparently placed too much emphasis upon the significance of bacteria as determining factors in the etiology of caries. Oral lactobacilli and other aciduric bacteria can be isolated from mouths of caries—immunes as well as from individuals with active lesions.

A recent study (17) of the diastatic activity of saliva showed that a striking correlation existed between ptyalin content and caries activity. It seems that numbers of oral aciduric bacteria are not important in themselves. These organisms require simple sugars for acid production, and it is possible that in this respect diastatic activity is an essential factor. By virtue of the action of ptyalin on complex carbohydrate, simpler sugars are formed and thus made available for acid fermentation by aciduric bacteria that are almost invariably present regardless of the absence or presence of decay. This theory may aid in explaining why Jay (18) has been able to control lactobacilli in some cases by restricting sugar alone, while, with other individuals, both sugar and starch had to be restricted to control the action of lactobacilli.

SUMMARY AND CONCLUSIONS

1. Data indicated that certain oral streptococci and staphylococci may produce as much acid as lactobacilli. 2. The S form of oral lactobacilli was capable of much greater acid production than the R form. 3. No correlation could be made between the absence or presence of dental caries and the amount of acid formed by microorganisms from which individuals they were respectively isolated. 4. Aciduric streptococci and staphylococci were isolated consistently from both carious and non-carious individuals. Their high acidogenic powers and presence in relatively large numbers in saliva suggests just as significant a role in caries as lactobacilli. 5. It is believed that the mere presence of oral aciduric bacteria is not the important factor in dental decay, since just as highly acidogenic types were obtained from immune as from carious individuals. Other factors seem of greater significance.

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EFFECTIVENESS OF ANTIBACTERIAL AGENTS USED IN CAVITY STERILIZATION[1]

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The elimination of bacteria from the dentin of carious cavities may be realized by a combination of 3 operations: 1. Mechanical removal of all carious dentin; 2. Antiseptic treatment of the dentin of the cavity; 3. Sealing the dentin against further penetration of saliva. It has been shown (25, 26) that, in the majority of cases, any one of these factors, by itself, can not be relied upon to sterilize the dentin. The mechanical removal of carious dentin and the sealing of the dentin by filling materials are procedures under the control of the operator. A dentist can be reasonably sure of excavating all carious tissue and of sealing the dentin against further penetration of saliva. However, the dentist has no control over the antiseptic treatment of the dentin of the cavity.

The desire for sterility of the dentin springs from previously recorded evidence (26) showing living bacteria, commonly associated with dental caries, to be present in the dentin of cavities which had been sealed for at least a year. The possibility of recurrence of decay due to these organisms can not be overlooked. The application of an antibacterial agent to the dentin prior to insertion of a filling material is a simple operation requiring expenditure of little time and there is no justification for leaving it undone.

The purpose of this paper is to record the results of an investigation of the efficiency of various drugs in the sterilization of dentin. The present work is based upon the method of investigation previously reported (27) and is a continuation of that study. The method, briefly, was as follows:

Occlusal cavities in lower molars were selected at random in clinic patients and prepared under aseptic conditions. Shavings of the dentin were cultured. A medicament was applied to the dentin for 3 minutes and then the cavity was sealed with a combination of gutta percha and a quick setting zinc oxid-eugenol cement. The patient was dismissed for 1 to 2 weeks. Upon the return, the temporary filling was removed aseptically and shavings of the dentin again cultured. By comparing the percentages of successfully sterilized cases obtained with each medicament, it is possible to evaluate the various drugs tested.

In order to standardize the procedure as nearly as possible, and thus to make comparisons simpler, it was decided to confine the work to medium[3] and deep[4]

[1] This study was aided by a grant from the William John Gies Fund of the American College of Dentists. Received for publication December 12, 1941.

[2] Now on active duty with U. S. Army (D. C.).

[3] Cavities in which the dentin was involved but in which there was a sound layer of dentin between the floor of the cavity, after preparation, and the pulp.

[4] Cavities in which the dentin was involved to a great extent and in which there was no sound layer of dentin between the floor of the cavity, after preparation, and the pulp.

cavities. Shallow[5] cavities were eliminated because there was a good chance that, after preparation, the dentin would be steril. Testing a medicament on such dentin would, of course, cast no light on the efficacy of the treatment. Likewise, obtaining steril initial cultures of dentin of any medium and deep cavities resulted in eliminating such cavities from the study since results of treatment would not be significant.

With each drug, the dentin of 20 teeth (10 medium and 10 deep cavities) was tested. Cultures of the dentin, before and after treatment, were examined microscopically to ascertain the presence or absence of bacteria. Although the morphologic form of the organisms was recorded, no attempt was made to determine the identity of the bacteria.

The medicaments tested were:—70 per cent ethyl alcohol, 10 per cent aqueous solution of sodium carbonate, a mixture of isomeric chlorphenolates (Phenolate), hexylresorcinol (solution S. T. 37), beechwood creosote (U. S. P.), a mixture of alkyl-dimethyl-benzyl ammonium chlorides (Zephiran) and 4 nitro 3–5 biacetoxymercuri-2-cresol (Metaphen).

TABLE I

	BEFORE TREATMENT					AFTER TREATMENT							
	No. of cases	Medium		Deep		Medium		Deep		Total		Per cent	Per cent
		+	0	+	0	+	0	+	0	+	0	+	0
No sterilization	20	10	0	10	0	9	1	10	0	19	1	95	5
70% Ethyl Alcohol	20	10	0	10	0	8	2	9	1	17	3	85	15
10% aqueous sol. of sodium carbonate	20	10	0	10	0	8	2	10	0	18	2	90	10
Phenolate	20	10	0	10	0	1	9	2	8	3	17	15	85
Hexylresorcinol	20	10	0	10	0	3	7	5	5	8	12	40	60
Beechwood creosote	20	10	0	10	0	5	5	8	2	13	7	65	35
Zephiran	20	10	0	10	0	5	5	6	4	11	9	55	45
Metaphen	20	10	0	10	0	3	7	4	6	7	13	35	65

RESULTS

Table I records the results obtained with each medicament. Twenty controls and 140 test cavities were used. Of the 140 cavities, 63 (45 per cent) remained positive despite treatment. Although only 77 (55 per cent) cavities were sterilized, it must be borne in mind that one of the agents tested (sodium carbonate) was of questionable value as a germicide; another (70 per cent ethyl alcohol) is not recognized as a powerful antibacterial agent. No drug tested heretofore has been able to sterilize the dentin in 100 per cent of the cases as might be expected because it is virtually impossible to remove all infected dentin in deep cavities. Treatment of dentin with a germicide is of value in eliminating, or at least inhibiting, bacterial growth. This can be ascertained readily by comparing the percentage of negative cases obtained

[5] Cavities in which the process of caries had involved only the enamel or had progressed to a minor extent into the dentin.

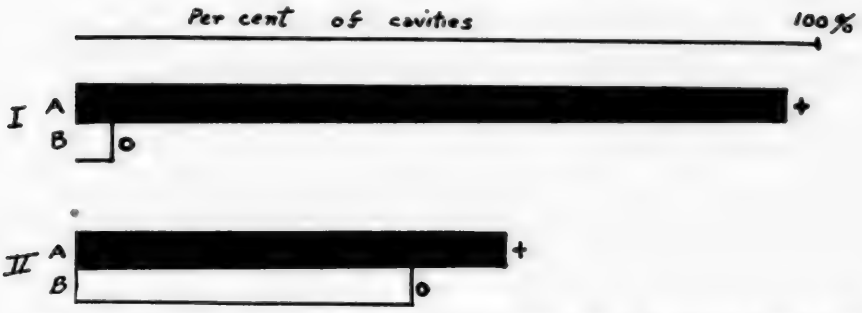

FIG. 1. Comparison of cultures from untreated dentin (I) and treated dentin (II). A-positive cultures; B-negative cultures.

with treatment to the percentage of negatives obtained without treatment (*fig. 1*).

No sterilization

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT	
	Per cent +	Per cent 0	Per cent +	Per cent 0
Medium	100	0	90	10
Deep	100	0	100	0

No sterilization: Of the 20 control cavities, only 1 became sterile 1 week later. The persistence of these organisms in the dentin even 1 year later has been demonstrated (26). No proof exists that the placement of a germicidal cement or the oligodynamic action of the metallic filling material may inhibit the growth of these organisms. It is better to obtain sterility of the dentin before insertion of the restoration than to depend on the possibility of obtaining it at some future time.

Ethyl alcohol (70 per cent)

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	0	80	20	15%
Deep	100	0	90	10	

Ethyl alcohol (70 per cent): Seventy per cent concentration has long been recognized as optimum for ethyl alcohol used as an antiseptic. Great reliance has been placed upon alcohol for various purposes in dentistry, although critical tests have conclusively demonstrated that only the less resistant organisms are killed (14). Many dentists use this solution for cavity sterilization. The futility of this procedure can now be recognized when it is noted that only 3 of the 20 cases were sterilized. The application of alcohol to a cavity is usually

painful. Its use should be discouraged. Alcohol is also used as a swab in the cavity after the application of phenol. The therapeutic value of this procedure is not understandable to the author.

Sodium carbonate

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	100	80	20	10%
Deep	0	0	100	0	

Sodium carbonate (10 per cent aqueous solution): A solution of sodium carbonate was tested for 2 reasons:—1. Numerous investigators (Black (1), Miller (19), Williams (2), etc.) have shown colorimetrically that carious lesions are acid in reaction. Hanke (10), using a yellow alcoholic solution of methyl red, computed the pH of dried carious lesions in teeth in the mouth to be about 5 or below. Grossman (9), with Beckman pH apparatus, found the mean pH of carious dentin to be 6.51. Regardless of the divergence of figures, all investigators agree that the pH of the carious lesion is on the acid side. It seemed, therefore, that treatment of the dentin of a carious cavity with an alkalin solution would be efficacious. 2. Rosenthal, McNabb and Snyder (23), in their search for an antibacterial factor against oral spirochetes in the saliva, found the factor to be sodium carbonate. There was no indication that this chemical would have any antibacterial value against organisms found in a carious cavity. Nevertheless it was felt that, since an alkalin agent was to be tested, sodium carbonate, a chemical already proven to have antibacterial value (20), should receive preference.

The failure of sodium carbonate to sterilize the dentin in 18 of the 20 cases seems to disprove the author's conjecture that the organisms of dental caries would be unable to survive in an alkalin medium. However, the thought occurred that perhaps the alkalinity produced was of such short duration as to be of little or no value. In order to investigate this point, brom thymol blue, an indicator having a pH range of from 6.0 to 7.6, was utilized. Several cases were selected. When the cavity was prepared (under the rubber dam), a pellet of cotton moistened with brom thymol blue was placed into it and allowed to remain for about 1 minute. The color of the pellet was then compared with the colors on Clark's chart (3). In each case the pH was found to be about 6.4 to 6.6. The cavities were then dried, treated with a 10 per cent solution of sodium carbonate for 3 minutes, dried, and tested with brom thymol blue again. This time, as expected, the pH was about 7.2 to 7.4. The cavities were then sealed and the patients dismissed. When the dentin was tested a week later, the pH was found to be approximately the same as it was originally. It must be concluded that the inability to keep the dentin in an alkalin state, and not the alkalin solution itself, was the predominate cause of the failure. If some means could be devised to keep the dentin alkalinized for a

definite period of time, it is possible that the organisms would be unable to survive.

Isomeric chlorphenolates

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	100	10	90	85%
Deep	0	0	20	80	

Mixture of isomeric chlorphenolates (Phenolate): The use of this drug was suggested to the author by Dr. Bernard Witlin (30) of the Philadelphia College

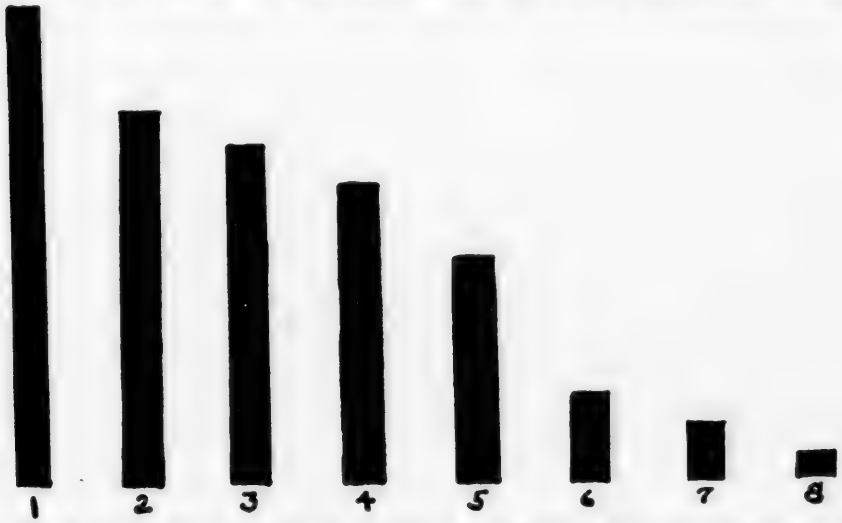

FIG. 2. Comparitive effectiveness of various medicaments used for sterilization of dentin. 1-phenolate; 2-metaphen; 3-hexylresorcinol; 4-zepharan; 5-beechwood creosote; 6-70 per cent ethyl alcohol; 7-10 per cent sodium carbonate; 8-no sterilizing agent.

of Pharmacy and Science. Phenolate had not been used as a therapeutic agent in medicine and dentistry. It is an oily, colorless liquid having a slightly pungent odor and an acrid taste which can be masked by the addition of eugenol. It is soluble in alcohol, acetone and the glycols and only slightly soluble in water. It is a derivative of 2-chlor-ortho-phenyl phenol.

According to Witlin this chemical has a phenol co-efficient of 125[6] against *Staph. aureus* and 100 against the typhoid bacillus. Megatherium spores $\frac{1}{80}$ billion, rusted on tenpenny nails and dried in an incubator at body temperature for 1 week, were killed by 1 hour's exposure to the 5 per cent tincture. A 1 per cent tincture was capable of producing a 20 mm. zone of inhibition in the standard agar cup plate method of testing antiseptics.

[6] By F. D. A. Method (Circular #198—U. S. Food & Drug Administration).

Although considerably more powerful than phenol as a germicide, phenolate fortunately does not inherit some of the former's undesirable properties. For example, the finger can be dipped into a bottle of the drug but no charring and subsequent sloughing of the tissues will occur. Phenolate has also been dropped on the mucosa of the oral cavity without causing a slough. In a few individuals, who seem to have an idiosyncrasy to the drug, a slight burning and itching sensation occurs but there is no further irritation.

The most important characteristic from the standpoint of this paper, however, is its ability to sterilize the dentin of carious cavities. Phenolate is the best drug that has been tested for this purpose (*fig. 2*). Any drug which sterilizes more deep cavities than it fails to sterilize must be a powerful germicide. There are only 2 such medicaments in this study (Phenolate and Metaphen), with another (Hexylresorcinol) on the border line.

Hexylresorcinol

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	0	30	70	60%
Deep	100	0	50	50	

Hexylresorcinol (*Solution S. T. 37*): According to Leonard and Feirer (15), hexylresorcinol is "a solution containing 30 per cent of glycerin and 70 per cent of water in which is dissolved 1 milligram of crystalline hexylresorcinol per cubic centimeter (solution S. T. 37)." It is a stable, non-toxic solution and a powerful surface tension reducent (16). The toxicity of this solution, according to Salle, McOmie, Shechmeister and Foord (24), is low.

The properties enumerated above plus its powerful germicidal action seem to indicate this drug as one which is well adapted for use in cavity sterilization. The results obtained with this agent were good in medium cavities; in the deep cavities only 2 medicaments were better.

Beechwood creosote

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	0	50	50	35%
Deep	100	0	80	20	

Beechwood Creosote (*U. S. P.*): Beechwood creosote is a complex mixture of phenols obtained from the destructive distillation of wood. Its chief ingredients are guaicol and creosol. It is used in medicine as an expectorant and as a germicide. Excellent results in cavity sterilization with a variety known as Morson's Kreosote have already been reported (27). Since this is a proprietary preparation, efforts were made to ascertain the differences between this solution and the ordinary beechwood creosote (U. S. P.). Neither

the Council on Dental Therapeutics of the American Dental Association nor the British Dental Journal were able to furnish any information on the subject.

According to Gershenfeld, Pressman and Wood (8), it is probable that different varieties of creosote, as purchased on the market, have different phenol co-efficients. They found 1 sample of creosote to have a phenol co-efficient against the typhoid bacillus of 3.9 and against *Staph. aureus* of 3.8, while another sample gave a coefficient of 2.45 against both of these organisms. The difference may be due to the varying percentages of guaicol and creosol in the different preparations. According to the Extra Pharmacopoeia (17), Morson's Kreosote is representative of a class consisting chiefly of creosol, whereas other creosotes contain a large percentage of guaicol. Our results with beechwood creosote (U. S. P.) bear out, clinically, that which Gershenfeld, Pressman and Wood showed in their *in vitro* studies. The percentage of successfully sterilized cases does not compare with the previous high percentage obtained with Morson's Kreosote.

Alkyl-dimethyl-benzyl-ammonium chlorides

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	0	50	50	45%
Deep	100	0	60	40	

A mixture of high molecular alkyl-dimethyl-benzyl-ammonium chlorides (Zephiran): Zephiran is the trade name for a quaternary ammonium type of wetting agent. It is an amber-colored solid of soap-like consistency. In aqueous solution it is a stable, colorless, saponacious, alkalin solution. Numerous investigators (Domagk (5), Heineman (11), Dunn (7), Walter (28), etc.) have reported on the germicidal, antiseptic, physical and chemical properties of this drug. According to these investigators, it possesses a high degree of germicidal efficiency together with excellent wetting, detergent, emulsifying and emollient properties. Miller, Baker and Harrison (18) found that it markedly inhibited the metabolism of 5 organisms commonly associated with dental caries. All these facts seemed to indicate that this drug was the ideal type for use in cavity sterilization. The mediocre percentage (45 per cent) of successfully sterilized cases, however, seems to contradict the high opinion of this drug obtained by a review of literature.

4 Nitro-3,5 biacetoxymercuri-2-cresol

TYPE OF CAVITY	BEFORE TREATMENT		AFTER TREATMENT		STERILIZING VALUE
	Per cent +	Per cent 0	Per cent +	Per cent 0	
Medium	100	0	30	70	65%
Deep	100	0	40	60	

4 Nitro-3, 5 Biacetoxymercuri-2-Cresol (Metaphen): Metaphen is a heavy, yellow powder, insoluble in water but soluble in 500 parts of dilute aqueous

sodium hydroxide of pH 9, and soluble in 50 parts of 95 per cent alcohol. Approximately 60 per cent of Metaphen is mercury. Its powerful germicidal properties have been described by numerous investigators (Raiziss and Severac (21), Douglas and Birkhaug (6), Crittenden (4), etc.). As a skin disinfectant, metaphen has given variable results; excellent for some workers (12, 22, 13) and unsatisfactory for others (29).

Salle, McOmie and Shechmeister (24) tested compounds for their toxicity to living embryonic tissue as well as for their ability to kill bacteria. From this they evolved the toxicity index which is "the ratio of the highest dilution of disinfectant showing no growth of embryonic tissue in 10 minutes to the highest dilution required to kill the test organism in the same period of time." The toxicity of metaphen was found to be low.

The aqueous solution 1–500 was used in this investigation since it was felt that factors such as acetone and alcohol in the tincture might influence the results. Generally speaking, the good results obtained with this solution can be attributed to the high germicidal efficiency of the compound together with its pronounced bacteriostatic effect. The results obtained with the aqueous solution of metaphen 1–500 indicate it as a satisfactory germicide to use in cavity sterilization.

SUMMARY AND CONCLUSIONS

1. Tests, by an *in vivo* method, were conducted on the dentin of prepared cavities to compare the sterilizing action of a series of drugs. 2. A new drug, heretofore, not used for therapeutic purposes in medicine or dentistry, was found to give the best results. This drug, a mixture of isomeric chlorphenolates (called phenolate for convenience) successfully sterilized the dentin in 85 per cent of the cases. 3. Good results were obtained with an aqueous solution of metaphen: 1–500 and with hexylresorcinol (solution S. T. 37). 4. The other drugs tested (Zephiran, beechwood creosote (U. S. P.), 70 per cent ethyl alcohol and 10 per cent sodium carbonate) yielded increasingly poorer results in the order in which they are listed.

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OPSONIN IN SALIVA[1]

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Recklinghausen (1) was probably the first to explain the finding of leukocytes on mucous surfaces as being due to a migration of these cells from the blood vessels through the epithelium to the mucous surface. He felt special attention should be paid to "the mucous corpuscle of the intestine and the salivary corpuscle in the saliva". Since that time various investigators have confirmed the presence of salivary leukocytes (2, 3, 4, 5, 6, 7, 8, 9).

Although it has been assumed that the leukocytes in the saliva are able to take up bacteria (10), and that a different reaction of leukocytes in the saliva of caries-active and caries-inactive mouths has been demonstrated (11), no definite evidence of a phagocytic function or of a difference under various conditions has been presented. Attempts to establish direct evidence were unsuccessful because it was impossible to secure a sufficient number of leukocytes from the saliva for the tests. Therefore, an indirect method was used. If the salivary leukocytes do take up bacteria, there are 2 prerequisites: 1, the cells must be viable and 2, there must be opsonin in the saliva. The viability of the leukocytes was indicated by their ameboid motion observed in a drop of saliva secured from the buccal fold and stained with brilliant cresyl blue. The primary purpose of this report is to present the results of a study of the existence of opsonin in the saliva and the method applied.

With the exception of Hugenschmidt's work (12) no experiments have been done to determine the presence or absence of opsonin in saliva. Hugenschmidt's experiments showed that the saliva is chemotactic and that leukocytes mixed with saliva take up bacteria. His theory was that saliva, being chemotactic, induces diapedesis into the oral cavity and that the leukocytes then engulf oral bacteria. However, Hugenschmidt secured the phagocytes for this experiment from the peritoneal cavity of guinea pigs and he did not wash them before adding them to the saliva. Consequently, some of the opsonin undoubtedly was derived from the peritoneal fluid.

For the study of opsonin in saliva leukocytes, bacteria and serum or saliva are necessary.

METHOD

Leukocytes: Ten cc. of blood were secured from the cubital vein of ambulatory patients visiting a hospital clinic. Five cc. were immediately placed in a centri-

[1] Read at a meeting of the Chicago Section of the International Association for Dental Research, November 14, 1941. Received for publication January 20, 1942.

fuge tube containing a few crystals of neutral potassium oxalate. The tube was inverted slowly several times. The other 5 cc. were placed in a centrifuge tube and allowed to clot. The oxalated blood was centrifuged slowly for ½ hour at the end of which time the white cells had collected in a gray layer below the plasma and on top of the red blood cells in the "buffy coat". The plasma was pipetted off and then the buffy coat. The latter was put into a centrifuge tube of physiologic salt solution. The tube was inverted carefully several times and centrifuged slowly for ½ hour when the physiologic salt solution was pipetted off and fresh salt solution added. The white cells were washed in this manner 4 times, the purpose being to free them of the opsonin-containing serum.

Bacteria: The organisms used were a strain of *Lactobacillus acidophilus* recently isolated from the saliva of an individual with rampant caries and a strain of an oral, acid-producing streptococcus also isolated from the saliva of an individual who had rampant caries. Both organisms were grown 24 hours in a 1 per cent dextrose broth. An oral strain of *Sarcina lutea* was used as well and was grown 24 hours in plain broth. The organisms were washed twice and suspended in 2 cc. of salt solution.

Serum and saliva: The serum was obtained by centrifuging the tube containing the 5 cc. of clotted blood and pipetting off the supernatant serum. Two to 5 cc. of unstimulated saliva were collected from each patient studied. Forty-one patients have been tested, some of them several times.

For the actual test Wright's procedure was followed. The usual capillary pipette was bent at a right angle. A mark was placed on the capillary about 1½ inches from the end. The washed leukocytes were drawn up to the mark, then the washed bacteria, then the saliva, serum or salt solution as the case required. The constituents were drawn into the bulge of the pipette and were thoroughly mixed, after which the end of the pipette was sealed and the mixture incubated for 20 minutes. After incubation the end of the pipette was broken off, the ingredients mixed again by pulling them back and forth through the capillary and then the whole mixture was blown out on a clean glass slide, smeared and stained with Wright's stain. Fifty polymorphonuclear leukocytes were counted and the percentage of those taking up bacteria calculated.

RESULTS

Table I shows the procedure followed for each of 59 phagocytic tests of saliva from 41 patients. Table I was selected as a typical example. P25 is saliva from an individual who had dental caries in $\underline{|5}\ 7, \underline{5|}, \overline{|5}\ 4, \overline{7|}$.

Controls 1 and 2 consisting of leukocytes, *L. acidophilus* or an acid-producing streptococcus and physiologic salt solution show that in spite of washing 4 times the leukocytes still show 2 per cent and 4 per cent phagocytosis, respectively.

Controls 3 and 4 consisting of leukocytes, bacteria and serum show the high opsonic activity of the serum and also that the leukocytes were not injured by the washing. Washing more than 4 times damaged the leukocytes so that the percentage of cells taking up bacteria was lowered markedly.

For tests 1 and 2 leukocytes, bacteria, and saliva were used. The results show

that the percent of phagocytosis in 1 and 2 (14 per cent, 10 per cent) is smaller, apparently, than the percent of phagocytosis in Controls 3 and 4 (100 per cent, 98 per cent) but higher than in Controls 1 and 2 (2 per cent, 4 per cent).

For tests 3 and 4 leukocytes, bacteria, serum and saliva were used to check the influence of saliva on the phagocytic effect of a system consisting of leukocytes, bacteria and serum. The results (82 per cent, 76 per cent) reveal that the number of cells taking up bacteria is smaller than in a system without saliva as in Controls 3 and 4 (100 per cent, 98 per cent) but larger than in a system without serum as in Tests 1 and 2 (14 per cent, 10 per cent).

TABLE I

NUMBER	CONTENTS	PHAGOCYTOSIS
		per cent
Control 1	Leukocytes + L. acidophilus + Salt Solution	2
Control 2	Leukocytes + Streptococcus + Salt Solution	4
Control 3	Leukocytes + L. acidophilus + Serum	100
Control 4	Leukocytes + Streptococcus + Serum	98
Test 1	Leukocytes + L. acidophilus + P25	14
Test 2	Leukocytes + Streptococcus + P25	10
Test 3	Leukocytes + L. acidophilus + Serum + P25	82
Test 4	Leukocytes + Streptococcus + Serum + P25	76
Test 5	Leukocytes + L. acidophilus + Serum + Salt	98
Test 6	Leukocytes + Streptococcus + Serum + Salt	94

TABLE II

NUMBER TESTS	ORGANISM	PHAGOCYTIC RANGE
6	Sarcina lutea	0–30
21	Streptococcus	0–38
32	L. acidophilus	0–78

Tests 5 and 6 were made in order to have controls diluted to the same extent as 3 and 4. The results of Tests 5 and 6 (98 per cent, 94 per cent) show that the decrease in phagocytosis in 3 and 4 (82 per cent, 76 per cent) compared with Controls 3 and 4, and Tests 5 and 6 (100 per cent, 98 per cent, 98 per cent, 94 per cent) is due to some factor in the saliva and not due to dilution. The nature of the factor which inhibits the ability of serum to stimulate phagocytosis has not been identified.

The experiments exemplified in Table I show that in a large number of cases the tested saliva contained a factor which stimulated phagocytosis. This factor shows a variability with the same and with different bacteria (Table II).

Opsonin is known to be absorbable and thermolabile. To study the phagocytosis-stimulating factor in saliva in respect to absorbability and thermolability, 2 absorption tests were made with saliva which had shown a marked ability to stimulate phagocytosis. A 24 hour culture of *L. acidophilus* was washed twice. After the last centrifuging the organ-

isms were left packed in the bottom of the tube. The salt solution was decanted and 2 cc. of freshly secured, unstimulated saliva were added, the organisms were mixed thoroughly with the saliva and the mixture was incubated for 2 hours. It was then placed in the ice-box for 12 hours. Two cc. of untreated saliva were incubated for the same length of time as a control. At the end of 12 hours the saliva was centrifuged to throw down the organisms. The supernatant saliva was pipetted off and phagocytosis experiments were made.

The 2 samples of saliva used for the absorption tests were P36 and P41. After absorption P36 showed only 4 per cent of the leukocytes taking up bacteria while the control showed 34 per cent. P41 after absorption also showed only 4 per cent of the leukocytes engulfing bacteria while the control showed 44 per cent.

The thermolability of the phagocytosis-stimulating factor in the saliva was studied in the following manner: Saliva which had been shown to stimulate phagocytosis markedly was heated to 60°C for ½ hour. Phagocytosis tests were then made with the heated and unheated samples of saliva. A few drops of unheated saliva were added to the heated in order to ascertain if it is possible to reactivate heated saliva.

The results of this experiment show that when heated saliva is used only 8 per cent of the leukocytes take up bacteria. When heated saliva is reactivated by adding a few drops of unheated saliva to it, 24 per cent of the leukocytes engulf bacteria. The unheated control stimulated 26 per cent of the leukocytes to take up organisms.

The absorption tests and heating experiments indicate that the phagocytosis-stimulating factor in saliva is absorbable and thermolabile.

SUMMARY

The presence of a phagocytosis-stimulating factor in saliva was established by tests with the saliva of 41 patients selected at random. Proof of the identity of this factor as opsonin was secured by absorption and heating experiments. It was possible also to reactivate the heated saliva. In addition, it was found that there may be a factor in saliva which reduces the ability of serum to stimulate phagocytosis. The nature of this factor has not been determined.

We should like to express our gratitude to Dr. Ludvig Hektoen for his advice, suggestions and criticism.

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INTERNATIONAL ASSOCIATION FOR DENTAL RESEARCH

Proceedings of the Twentieth General Meeting[1]

The Commodore, New York, N. Y.

March 14 and 15, 1942

Compiled by HAMILTON B. G. ROBINSON, *Editor*[2]

Washington University, St. Louis, Mo.

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I. Address of Retiring President

The Work and Functions of the International Association for Dental Research

Isaac Schour, D.D.S., Ph.D., Sc.D., College of Dentistry, University of Illinois, Chicago, Ill.

The address of the retiring president, while not subjected to any rationing, is traditionally brief. I shall therefore confine my remarks to a progress report of the accomplishments of our association during the last year and a projection of our possible progress in the future.

Journal of Dental Research. In spite of the fact that our foreign circulation is practically stopped and in spite of the increasing amount of energy that is being expended by our profession in war efforts, our Journal has enjoyed a 35% increase in subscription and in the number of published articles. There has also been an increase in the speed of publication.

We owe our deep gratitude to the Publication Committee whose official report

[1] The sessions of the International Association for Dental Research preceded by agreement, those of the 19th Annual Meeting of the American Association of Dental Schools, in the same Hotel, March 16–18. Members of each body were welcome at, and participated in sessions of both Associations. The annual informal dinner was served to 132 members and guests at the Columbia University Club, March 15.

[2] The Editor of the Association received invaluable aid from General Secretary Edward H. Hatton in preparation of these proceedings.

you will read in the published proceedings. The unselfish and devoted efforts of Drs. Robinson, Hall and Arnim are especially commendatory since they have brought the Journal of Dental Research to a higher level of stability and usefulness in spite of the added load of teaching they have had to carry as a result of the war.

The attention of the dental profession has been called to the function and nature of the Journal of Dental Research not only by the subscription campaign but also by the exhibit of the Journal which has been shown at a numberof dental meetings throughout the country.

In anticipation of the increased calls for back issues of our Journal in order to complete the files that have been interrupted during the war, Drs. Hall and Arnim of our Circulation Office have been accumulating a number of volumes that will be available to our foreign subscribers as soon as the present crisis is ended.

Dr. Robinson reports that 6 foreign papers were received during the last year. One of these was lost twice in transit and finally sent by diplomatic pouch.

Advance Abstracts of the Proceedings of the General Meeting. Another important stage in the growth of our association has been reached as a result of the efforts of Dr. Hatton. Without coercion but by patient and persistent appeals during the last few years he has so succeeded in establishing the habit of submitting the abstracts ahead of time that this year a 100% response has been achieved. The birth pains occasionally associated with the preparation of abstracts have not been entirely eliminated but at least they have been considerably reduced. We may look forward with confidence to the near future when our members will receive the issue of the Journal of Dental Research containing the abstracts of the papers several weeks preceding the meeting.

In accordance with the provision of our new By-laws, our secretary has revised our membership lists so as to exclude those members who have been in arrears for three years and thus automatically forfeited their membership in the association. Our December issue of the Journal contains an alphabetical list of our membership.

This report would be incomplete without recording my sincere appreciation and that of the association of the untiring and unselfish services of Dr. Hatton. The success of this meeting is largely the result of the continuity of his efforts and his devotion to our organization.

I also wish to express my appreciation of the work of the Local Arrangements Committee under the leadership of Drs. Bodecker and Neuwirth.

Projection of Future Progress. Fortified by our steady progress made during the last year, we may look forward to still further advance in the immediate future. In what direction will this progress be? The following are some of the possibilities that suggest themselves:

1. *The Journal of Dental Research.* Increased support of our Journal will continue to come from two important sources: the increase in the number of subscribers and the completion of the Gies Endowment Fund. Our Circulation

Committee reports that the percentage of our members who are subscribers to our Journal has increased considerably and that there is promise that eventually a 100% voluntary participation of our membership will be attained.

The splendid support of the Journal through subscriptions and the Endowment Fund presents an added challenge to increase its usefulness. This will be achieved by increasing the number and quality of the published reports. The Journal has increased its pages steadily during the last five years. Greater increases with almost immediate publication should be possible when funds from the endowment are made available.

Research progress cannot be measured merely by the accumulation of new facts. An additional requisite is the preservation and cultivation of a research attitude and activity that combine the discipline of a special field with the philosophical interest in other fields of knowledge. The inclusion of reviews of general fields would help to coordinate the findings that have come from different sources and would afford a common meeting place for the various specialized fields.

2. *Increased Discussion at Our General Meetings.* Our scientific sessions this year have been enriched by more frequent discussions than at previous meetings. This was made possible in part by the splendid spirit of cooperation of a number of our members who withdrew their reports from the scientific program in order to free more time for discussion.

We know that a diet deficient in vitamins and minerals results in retarded growth and disturbed calcification. Similarly a scientific meeting deficient in discussion may result in mental starvation. Discussion in proper proportion is essential. It can become the most vitalizing and stimulating accomplishment of the meeting. With the expected advent of the publication of our abstracts in advance of the meeting, members will be better prepared to raise questions or give constructive criticism.

3. *Organization of Research Sections of the I.A.D.R. in South America.* A number of us have been in personal correspondence with various dental investigators of South America and are acquainted with their research results published in scientific periodicals and monographs. Some of them have been elected to active membership at this meeting. We may look forward with confidence to the organization of research sections in the various centers of learning in South America.

4. *The Sponsoring of Lectures Before the Various Research Sections.* The stimulus that has always come from our annual meetings shows that the meeting of the mind and the exchange of ideas are essential to research progress. It may be true that talent develops in the quiet of solitude but it may also be said that its expression cannot be wholesome unless it be social and interdependent. Ideas may germinate in solitude but they will not bear fruit and develop into schools of thought except with the help of fellowmen.

Just as in national or international life, so in research, no one individual or group of individuals can be self-sufficient. It is the free interchange of information and ideas that makes for the best utilization of all resources. Such free

interchange has been effective through the medium of the Journal. Another valuable medium would consist of guest lecturers who would visit our sections bring to them a new message and in turn take with them the response and judgment of the host section. This method has been successfully employed by the Sigma Xi. Their experience would well serve as a basis for our consideration.

5. *The Sponsoring of Student and Local Research Clubs by the I.A.D.R.* Dr. Gies has repeatedly suggested that "our association should be kept a young man's organization." Of course youth is not a function of chronologic age alone. Mental youth exemplifies vigor and enthusiasm and alertness. These are the qualities of the research worker whether he be young or old, and are often found independent of age.

However, to promote and preserve the youthful spirit of research, it is important to initiate an appreciation of research as early as possible. The pattern of growth, whether it be of the tooth, the skull or the intellect, is established early in life and is not readily changed. It is therefore important that the research attitudes of mind be cultivated in the student as soon as we come in contact with him. The future leaders and devotees of dental research are among the students of today. We have the responsibility of discovering them as early as possible. This task does not supplant the work of our teachers but supports the aims and purposes of our schools. There should be some medium of activity whereby the responsibe students learn to recognize that the pursuit of Science cannot be fulfilled by a series of assignments disposed of nor with the passing of so many clock hours of the curriculum. The Pursuit of Science is not an Assignment but a Cause that comes from within and calls for voluntary but constant devotion and application.

The thought suggests itself that those of us who are fortunate in being in frequent association with the student body could sponsor, each in his own particular sphere of activity, a small group of students that would meet periodically but informally to discuss recent scientific developments, to evaluate critically the findings of current research reports and to exchange ideas on the past and future of dental research. Such student activity should be kept on a free and informal basis. It would gather strength in the intensity of the mutual interests and not in the number of the participants.

While such student groups could readily evolve independently and without any affiliation with a larger organization, they could draw encouragement and inspiration from a sense of belonging with a stronger, well-established sponsor organization such as the I.A.D.R. The research reports in the current issues of our Journal could well serve as a valuable source of material for discussion topics. Special student subscription rates would foster the habit of reading with discrimination and regularity.

Permit me to express my conviction that this tentative idea of organizing in our various schools small student research clubs is not Utopian. It is timely and feasible. The clubs would, of course, evolve slowly and it would at best take several years before any one of them would be ready to be admitted officially into the I.A.D.R. Only future developments would determine the manner of organization that would be best suited for this purpose.

This same type of organization is likely to serve as a nucleus for a research section in places where research sections have not yet been established.

6. *The War Efforts and the I.A.D.R.* The biggest challenge that confronts our Association today is to meet successfully the great responsibility that the War has placed upon us. First of all, each one of us individually and collectively is eager and ready to perform those tasks and duties for which we are best qualified. I am sure that I voice the unanimous concensus of our membership in affirming that the total resources and capacities of this association are at the service of our Government and the Allied Cause. We have the further responsibility of carrying on basic as well as applied research and of maintaining its continuity during this period when a large portion of Europe and the rest of the world is held under a dictatorship which has not permitted freedom in research but instead has exiled or placed in concentration camps many of the world's greatest scientists. Dr. Hatton reports that he has not heard directly from the majority of sections outside of the North American Continent. These sections will be rebuilt and will need our help. We must be prepared for this opportunity to do our share in the task of winning the peace after we have won the war.

II. Introduction of the President Elect

Leuman M. Waugh, D.D.S., School of Dental and Oral Surgery, Columbia University, New York, N. Y.

At the annual meeting in Cleveland it became my pleasant privilege to present an incoming president. He was the founder of the International Association for Dental Research. The organization meeting took place in this, the Columbia University Club. There were present twenty one chosen dentists who became the founder members.

Tonight it becomes my privilege to say a few words about another incoming president. He was not eligible for founder membership because he did not then reside in the New York area. However, he has the distinction of being the first *elected* member of the Association and more, he presented a research paper at the first meeting held. We assembled in this very room for dinner, some forty attending, and then convened just across the street to the old Academy of Medicine building for the scientific session. A large and representative audience awaited him and J. Leon Williams who shared the program of the evening. Thus was the International Association for Dental Research first introduced to the dental and medical professions in New York.

Dr. Charles F. Bodecker was born and reared in New York City. His summers were spent on the south shore of Long Island where water sports, with boating and sailing, became his boyhood hobby,—a hobby which has persisted to this day. After years abroad, it is pleasant to relate that he has acquired some of the family acres of his boyhood where he now weekends and spends his summers. Central Park was his city hunting grounds and many hours did he spend there, playing cops, hunting robbers and shooting Indians. His father, C. W. F. Bodecker, was a prominent dentist with an urge for research. He

wrote a book of over 600 pages entitled "Dental Anatomy and Pathology of the Teeth." He served also as Professor of Embryology at the University of Buffalo.

With this background and seventeen budding years to *his* credit, our young stalwart presented for matriculation at the University of Buffalo. It was here that we first met. He was big, he seemed shy. The Dean called him by his first name on the first day, much to the envy of his classmates. We thought he might hold himself aloof, coming from the great city of New York while the rest of us came from the "sticks" in Western New York. Our error, however, was discovered the next day when the junior class tried to show us freshmen who would run the Dental School. He loved nothing more than a friendly scrap, with classmate, upper class or the medicos.

Soon after he returned to New York I was asked the name of the research worker at Columbia University with the clergyman speaking voice. After casting about, I mentioned him; he was the one. I soon said that he was not like a clergyman but rather like the proverbial minister's son, for he could engage in more boyish deviltry, such as swiping bicycle racks, barber poles, large thermometers from outside drug stores, et cetera, than any man in the class. He often had me worried for we lived in the same house. But he was also diligent and capable and was graduated in 1900 with the degree of D.D.S. He was under age and had to wait for over a year to get his diploma.

His father and brother moved from New York to Berlin, Germany during his college course, establishing themselves there. He joined them upon his graduation. From 1900 to 1904 he continued his studies in natural sciences at the University of Berlin, engaging in research in the hard structures of the teeth. In 1902 the New York State Board examinations brought him back to America, whereupon our studious companionship of college days was resumed. The State Department of Education must have run out of gold seals, for his certificate had a purple seal and was inscribed "With Honor." Practice and research in Berlin again claimed him. This time his problem was the one in which his father had engaged for some twenty years. He sought to prove the physiologic relation of teeth to body as a whole, which concept was not then popularly believed. It is told that the intolerant and scoffing attitude of some fellow researchers so hurt the elder Bodecker that it was the deciding factor in his removing from New York. Be this true or not, it is a fact that he never again did microscopic work. Imagine the satisfaction to the father of his son's choosing to carry on in this field!

He continued his research with increased intensity and is *still* carrying on. In substantiation of his father's theory, three points especially stand out: A. Establishment of an organic matrix in dental enamel. B. Determined true presence of and named the "enamel lamellae." C. Finally proved presence of dental lymph in hard tooth structures. In 1912 he again visited America and gave me an autographed reprint of his then recent research report, a document I have always treasured and retained. We remember vividly our discussion concerning the x-ray and the detection of caries. It was the first time

my attention had been called to it. Now almost every dentist discerns caries by means of bite wing films.

He had always maintained American citizenship and in 1922 he returned and established himself in practice here and began teaching at Columbia University as Assistant Professor of Dental Histology and Embryology. He was elevated to Associate Professor in 1924 and to the full professorship and Chairman of the Research Committee in 1926 which positions he continues to fill. He was elected chairman of the Scientific Research Committee of the Dental Society of the State of New York in 1926, a position he has held ever since. He was appointed the State Board Examiner in Histology and Embryology in 1932, another position he continues to hold. He has made 1114 contributions to dental literature, including two text books. He is a member of Xi Psi Phi Fraternity, Omicron Kappa Upsilon and Sigma Xi.

Dr. Bodecker was signally honored in 1935 by the Dental Society of the State of New York in being made a "Fellow" of the Society and in being awarded the William Jarvie Medal in recognition of his "distinguished services to the science and art of dentistry." He is an active fellow of the New York Academy of Dentistry and of the American College of Dentists; associate fellow New York Academy of Medicine; honorary member, W. D. Miller Club of Berlin; fellow of American Association for the Advancement of Science; fellow of New York Academy of Science; active member of the First District Dental Society, State of N. Y.; the Dental Society of the State of New York, and the American Dental Association. His residence is Journeysend, Center Moriches, L. I. and his office address, Columbia University School of Dental and Oral Surgery, 630 West 168th Street, New York.

Fellow members, ladies and gentlemen, I take particular pleasure in calling upon our new president to now take over. May his year be one of unusual success.

III. Inaugural Address

Charles F. Bodecker, D.D.S., School of Dental and Oral Surgery, Columbia University New York, N. Y.

The report of the retiring president, Dr. Schour, embraces a number of excellent suggestions for the future policy of our Association. I should like to elaborate only on two of these recommendations.

His suggestion that sections of the International Association for Dental Research be founded in South America is good. Quite a number of South American investigators, many connected with teaching institutions, are active in worthwhile research. I, therefore, second the recommendation of Dr. Schour that an attempt be made to found sections of the International Association for Dental Research in South America.

Another suggestion of Dr. Schour deals with the formation of student research groups in our Schools. It is evident that our past president has been highly active in stimulating an undergraduate interest in research, realizing that

the present student body will have a determining influence on the future progress of the dental profession.

Here we have attacked this problem from a number of angles. The advantages of the senior thesis need not be described as it is used commonly. Another angle of approach was made by B. O. A. Thomas who organized an abstract society last fall, which group has had highly successful monthly meetings. The committee selects a number of recently published articles which are abstracted by senior students. The abstracts are mimeographed, 88 of which have appeared up to date, and presented at monthly meetings, one member of the teaching staff being selected to discuss each of the papers. A senior student acts as chairman and conducts the general discussion.

This method has shown the following benefits: 1. The student abstracting the article gains a permanent interest in the subject and will follow any further developments in the literature with intense interest. 2. The attending undergraduates of all classes will be stimulated by the fact that much research still is necessary to solve the pressing problems of dentistry. 3. The members of the teaching staff attending such abstract meetings will obtain information concerning topics which often are outside of their own field and thus widen their viewpoint and awaken them to the progress of research. The fact that many students voluntarily attend such meetings, after completion of their prescribed daily work, shows that their interest is truly awakened by this type of activity. I, therefore, heartily recommend this plan for a more universal adoption.

The writer of a president's report is in a unique position, inasmuch as he has two distinct advantages over most other speakers. He has complete liberty in choosing his subject and is assured that the majority of his audience will remain.

Many members of the International Association for Dental Research have listened to reports for some thirteen hours during the last two days and it is only natural that they should wish to relax and not be bored at this, the concluding session of the meeting. Consequently your speaker will not mention his own work, great as is the temptation to do so, but will confine himself to some generalities. These will be very brief.

Research may seem somewhat futile and unimportant during this time of stress. The present happenings probably will influence future living conditions but it should be a solace to this group of investigators that scientific discoveries will far outlive the overthrow of foreign governments. Science is necessary to the progress of the world, inasmuch as it leads to a more complete eradication of disease and a better comprehension of life.

A scientist's work progresses best if his mind is free from worry but this is an almost unattainable state after reading the daily papers. But he need not necessarily do this because his work is not dependent upon the details of the world's happenings. A business man, on the other hand must keep in touch with daily events, because these may affect his dealings. A scientist can live an entirely different kind of life and he should not be blamed if he segregates himself from the world's affairs; for only by isolation can most men give undivided attention to research.

Our particular subject of this discussion is research activity. A frequent criticism of laboratory research is that it is mostly impractical and consequently some persons believe it to be of little value. Such an opinion, we all know, arises only from a partial knowledge of the facts. It is true that many research reports do not have any immediate practical applications, yet the store of knowledge is increased by such discoveries and the horizon is widened so that later, it is often possible to make practical use of these research findings. An outstanding example is the discovery of the principle of the "Thermos" bottle. This idea was used in laboratories for many years, as, for instance, to preserve solid carbon dioxide gas for use in a freezing microtome. Later the public benefited by this principle so that foods could be kept hot or cold for long periods. The pity is that the discoverer of this principle gained no financial benefits, while others, who merely realized that people liked intensely hot or intensely cold foods on picnics, reaped fortunes from the practical application of this scientific discovery. There are many similar examples in which men have benefited financially by the discoveries of others.

The reason for bringing up this subject is that the researcher in the dental field often has a golden opportunity to make his work completely practical. It is regrettable that all too frequently this opportunity is allowed to slip by. The laboratory scientist engaged in certain dental problems can best apply his work clinically by having personal experience with oral conditions. It is for this reason that dentists who concentrate on a research career should not completely forget the dental clinic. The major problems of dentistry—dental caries and periodontoclasia—probably would be nearer a solution today if the clinical picture of this diseases had been examined and classified more critically by the laboratory researcher.

Many investigators in the dental field have no dental qualifications. In this case a collaboration with a competent clinician often brings results. A linking of the fields of theory and practice has been used more often during recent years resulting in interesting and valuable observations.

The motive which actuates men to select a research career is interesting. Success in research depends upon the characteristics of the persons engaged in conducting it. Naturally a young man or woman who wishes to enter research should be fitted for the job, and should have fundamental training in the subject. The successful research worker must be able to think logically, he must be well-balanced mentally, he must be critically skeptical but open to conviction. He must be honest with himself and willing to continue work in the face of criticism. He must be willing even to sacrifice financial gain to some extent. Many men who have made creditable contributions to research have not had all of these qualities at the outset, but have developed them. Older men often lacked university training and acquired their knowledge only by intensive home study.

It is true that the above mentioned qualities are possessed by many who do not turn to a research career. Often the research bent is apparent very early in life; it shows itself even in children who ask their mothers countless questions.

I know of a case of a boy of twelve tho took his watch apart, and when the main spring jumped out with a buzz, was satisfied that he had discovered the power which made it tick. At four years of age he cut into an expensive drum because he wanted to see what made the noise. This inquisitiveness is the first indication of a possible research candidate. However, many children are inquisitive and yet do not develop into investigators. The fault, or should we say the merit, lies in their parents, who discourage anything so impractical as research. Boys and girls are taught that financial benefits are far more important in life than the ideals of research. Many persons lack the essential motive for a research career, the wish to add their contribution toward alleviating the world's suffering or improving human welfare. Some researchers ridicule the thought that idealism is a power which drives an investigator in his study. These rather cynical critics believe that the research field is just like any job by which a living can be made. Some investigators may have this rather disparaging conception, but certainly not those men and women who had the free choice of selecting research or a more lucrative occupation. Those who select research under these conditions indeed are actuated by idealism.

This idealism was evident in Walter Reed, head of the American Yellow Fever Commission, who determined the cause of the disease and brought this dreaded plague under control. His work and that of his associates was the means of saving countless lives, and much suffering. Paul de Kruif in the "Microbe Hunters" quotes from a letter which Walter Reed wrote to his wife:

> "The prayer that has been mine for twenty years, that I might be permitted in some way or at some time to do something to alleviate human suffering, has been granted."

Some of the qualities have been mentioned which the ideal and able scientist should possess. On this occasion we wish to discuss only one of these, i.e., skepticism. Researchers may be divided into three groups on the basis of this quality: 1. blindly skeptical, 2. critically skeptical and 3. the gullible researcher.

Skepticism is a most important safeguard in research, because without it many a wrong observation or unsound theory would be accepted with subsequent loss of time and labor and the confusion of the final issue. However, skepticism can be overdone. The following is an example of the blindly skeptical investigator. A conference was held at which three investigators presented certain evidence to a man in an influential position. After about two hours, the latter became impatient and said, "I don't care how much evidence you have, you cannot make me believe it." This statement shows that a man can be wilfully engrossed in his skepticism to the detriment of progress and of his position.

Some persons like to be known as highly critical; this attitude is perfectly right and proper. But they frequently criticize material without having any specific knowledge of the subject. This is a mistake. Often those who pride themselves on their skepticism are at the same time most emphatic in the claim of possessing an open mind. They condemn men who make observations which apparently refute accepted theories and say they are "hipped" on their subject. An analysis of this "closed mind" skepticism shows that such a man may readily

himself be "hipped" on his particular pose. His attitude is frequently as harmful to progress in research as the other extreme type, the gullible investigator. The point is that skepticism is necessary, but it should be a *critical* skepticism, not a skepticism based on a blind prejudice. Anyone can and should criticize research reports *providing* they have studied and comprehended the evidence which forms the basis of the report. If he has no firsthand information on the subject, the self-imposed skeptic has no right to say: "I do not believe it;" he only can say: "I do not know."

An amusing example of group skepticism is cited by Paul de Kruif in his "Microbe Hunters." It was after Walter Reed had demonstrated clearly that the mosquito was the carrier of yellow fever. He stated in 1900:

"But still there came learned doctors, and solemn bearded physicians, from Europe and America, asking this, questioning that—and one morning fifteen of these skeptics were in the mosquito room of the laboratory—oh! they were from Missouri! 'These are remarkable experiments, but the results should be weighed and considered with reserve' et cetera. Then the gauze lid came off a jar of the she-mosquitoes (of course it was by accident) and into the room with wicked lustful eyes on those learned scientists, the stegomyia buzzed. Alas for skepticism! Away went all doubts! From the room rushed the eminent servants of knowledge! Down went the screen door with a crash—such was the vehemence of their conviction that Walter Reed was right. (Though it happened that this particular jar of mosquitoes was not contaminated.")

IV. Index of Participants and Sequence Numerals of Corresponding Abstracts

Aisenberg, M. S., 78; Applebaum, E., 95; Appleton, J. L. T., 36; Armstrong, W. D., 79, 80, 105; Arnold, F. A., Jr., 20, 21; Barnum, C. P., 80; Bartels, H. A., 31, 81; Bauer, W. H., 8; Beall, J. R., 18; Benzer, S., 55; Berger, A., 82; Bernier, J. L., 83; Beube, F. E., 7; Bevelander, G., 55, 84; Bibby, B. G., 45, 85; Bird, M. J., 67; Blattner, R. J., 72; Bodecker, C. F., 15, 77, 114; Bonner, J. F., 66, 68; Borden, I., 86; Bradley, J. L., 102; Breitner, C., 13; Brodie, A. G., 87, 115; Brodsky, R. H., 46, 88; Burket, L. W., 9; Burrill, D. Y., 56, 89, 90; Cahn, L. R., 6, 91, 92, 93, 94; Calamari, J. A., 27; Campbell, J., 86; Canby, C. P., 83; Cheyne, V. D., 41, 58; Cooper, E. N., 30; Criswell, J. C., 23; Dale, P., 16; Deakin, M., 61; Dean, H. T., 20, 21; Dessauer, G., 66; Diamond, M., 95; Dietz, A. K., 36; East, B. R., 96; Ehrich, W. E., 35; Elvove, E., 20, 21; Feldman, B. L., 97; Fleeman, J., 98; Foley, G., 33, 34; Foster, W. C., 23; Freeman, S., 110; Gafafer, W. M., 99; Gallup, H., 67; Gaudino, J., 67; Gilda, J. E., 64; Ginn, J. T., 5, 14, 16, 64, 66, 100, 116; Glickman, I., 11; Gootzeit, E. H., 32; Gordon, S. M., 74; Gore, J. T., 10; Gottlieb, B., 51; Grossman, L. I., 62; Gruber, I. E., 42; Hammond, C. W., 101; Hammond, W. M., 9; Hampp, E. G., 4; Harris, T. N., 35; Hatton, E. H., 102, 103; Healey, H. J., 41; Hemphill, C. D., 22; Heys, F., 72; Hill, T. J., 37; Hillier, H. W., 73; Hinds, E., 51, 52; Hinds, F. W., 53; Hodge, H. C., 66, 67; Hook, W. E., 108; Jump, E. B., 50; Kamen, P., 119; Karshan, M., 38, 39; Kelly, V., 80; Kittay, I., 119; Klatsky, M., 57; Klein, H., 59; Kniesner, A. H., 37; Knowlton, M., 79; Kogan, F., 111; Koss, W. F., 66; Kotanyi, E., 71, 104; Kreshover, S., 9; Lefkowitz, W., 15, 17, 97; Liebig, E. O., 28; Ludwick, N. V., 23; Lund, A. P., 105; Manly, R. S., 63, 106; Mann, A. W., 24; Maurer, D. W., 85; McCauley, H. B., 65; McClendon, J. F., 23; Miller, B. F., 47; Miller, H. G., 106; Miller, S. C., 40; Muntz, J. A., 48; Neuwirth, I., 60; Nuckells, J., 86; Oman, C. R., 1; Orban, B., 43; Pohlen, K., 96; Powell, V. H., 14; Rabkin, S., 44; Ray, K. W., 29; Rice, E., 31; Rice, T. B., 58; Robinson, H. B. G., 72; Rosebury, T., 33, 34; Rosenstein, S. N., 107; Rosenthal, S. L., 32; Salzman, J. A., 12; Sarnat, B. G., 87, 108; Schick, B., 46; Schlack, C. A., 22; Schoonover, I. C., 18; Schour, I., 75; Seidler, B. B., 40; Shapiro, H. H., 15; Siegel, E. H., 3, 109; Simmons, N. S., 69; Skillen, W. G., 110, 111; Skinner, E. W., 30; Sorrin, S., 112; Souder, W., 18; Spies, T. D., 24; Springer, F. M., 24; Stein, G., 2; Stephan, R. M., 47: Stowe, L. R., 109; Strock, A. E., 26; Summerson, W. H., 60; Svoboda, J. F., 25; Sweeney, W. T., 19; Taylor, D. N., 22; Tefft,

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V. First Session: Morning, March 14, Abstracts 1–11

1. Pulp capping of permanent teeth. *Carl R. Oman, D.D.S., and Edward V. Zegarelli, A.B., D.D.S., School of Dental and Oral Surgery, Columbia University, New York City, N. Y.* Material was collected over a period of more than 4 years from patients (10 to 78 years of age) in the school's infirmary. The exposures were made by dental students either during excavation of carious material or in preparing cavities for filling. There were no subjective symptoms prior to or at the time of exposure. The teeth were all tested with the Columbia University pulp tester, as an additional check on vitality. After pulp capping, patients were called in periodically for re-examination by radiographs, electric pulp tests and history of symptoms. Of 252 cases, 7 have been capped over 4 years; 42 over 3 years; 58 over 2 years; 44 over 1 year; 60 over 6 months and 23 have been capped less than 6 months. Of these, all but 18 were successful. The causes for failure were attributed to: 1. unfavorable cases for this procedure; 2. faulty technique; 3. loss of pulp capping material, resulting in re-exposure and undue irritation and, 4. lack of cooperation on the part of the patient; that is, failure to return for permanent protective filling.

2. The Gingivae and oral mucous membranes of monkeys in experimental hypothyroidism. *Daniel E. Ziskin, D.D.S., and George Stein, D.M.D., School of Dental and Oral Surgery, Columbia University, New York City.* Of 11 female rhesus monkeys, 4 were thyroid-ovariectomized and 7 were thyroidectomized only. Clinically, those thyroid-ovariectomized appeared myxedematous; gingivae were markedly thickened and violacious color, changes not as evident in thyroidectomized animals. Microscopically, changes were generally degenerative and of similar character for both groups, with minor differences. Castration alone produced more severe gingival reaction than combined castration and thyroidectomy. Evidences of degeneration: 1. Hyperkeratosis in alveolar and areolar gingivae (not marked in longer-lived animals). 2. Pyknosis and fewer nuclei in basal cell layer; many prickle cells without nuclei; perinuclear vacuoles. 3. Epithelial intercellular edema. 4. Increased mitosis in basal layer. 5. Hypertrophy of epithelium and connective tissue. 6. Thickening and coarsening of fibrous connective tissue bundles; edema between bundles, marked in upper third of corium and in areolar gingivae, with fragmentation of fibers. 7. Young fibroblasts in larger numbers than normal; mature normal fibrocytes greatly reduced in number; abundant pyknotic nuclei in lower third of corium; connective tissue more cellular than normal. 8. Young capillaries more numerous than normal; arterioles with thickened walls. Special stains disclosed increased amount of mucous staining material; and glycogen (possibly accounting for epithelial perinuclear vacuoles in H & E). Elastic tissue in corium swollen and fragmented. No fat in tissues.

3. Clinical, roentgenological, and histological studies of the teeth and gingivae of diabetic children and adults. *Daniel E. Ziskin, D.D.S.,*

and Eli H. Siegel, Sc.B., D.D.S., School of Dental and Oral Surgery, Columbia University, New York City. Group of 94 diabetic children (9 negroes), 47 boys and 47 girls, 3 to 18 years of age with duration of diabetes from 3 months to 15 years were studied for height, number of erupted teeth, teeth decayed, missing, filled (DMF), gingival appearance and crevicular depth, tooth deposits, occlusion and nutrition. No relation found between total erupted teeth and height. Using DMF indices of Klein, Palmer and Knutson (*Pub. Health Rep.:* **53:** 751, 1938) for Hagerstown, Md. children as a control, our group showed no significant difference in caries experience. About half had 21-film series of radiographs. Of these, 5 caries immune on clinical examination showed cavities, and additional cavities found in most of others. Tooth eruption accelerated only in about half the girls (not significant). Most of group showed thickened gingivae, violacious in color, and increased crevicular depth. About half had deposits on teeth, poor hygiene. Malocclusion common but not characteristic. Three had enamel hypoplasia in permanent teeth. No alveolar bone destruction. Gingival biopsies from 14 of these children and 5 diabetic, insulin treated adults (aged 21 to 63) showed: hyperkeratinization; pearls; hyperplasia of epithelium and connective tissue; increased collagen and young capillaries in corium with little inflammatory exudate; marked glycogen increase in epithelium particularly in areolar gingivae; no fat deposits. Gingivae appeared unusually healthy. Age at onset of diabetes, duration, daily insulin dosage, had no perceptible bearing on clinical or microscopic findings.

4. MICROINCINERATION STUDIES OF AN ENAMEL CONTAINING AMELOBLASTOMA. *Edward G. Hampp, D.D.S., M.S., National Institute of Health, U. S. Public Health Service, Bethesda, Md.* The presence of enamel in the ameloblastoma is an infrequent occurrence and has been reported on few occasions since 1885. The structure and development of the neoplasm closely resembles the histology and embryology of the developing enamel organ up to the stage at which enamel formation becomes evident. It is at this point that the true enamel organ and ameloblastoma diverge. A study of an ameloblastoma (received from the Department of Pathology of the University of Rochester School of Medicine) revealed an area containing a thin layer of enamel, deposited in close proximity to a partially calcified osteoid-like material. From all histological evidence, the cells comprising the enamel forming portion of the neoplasm have differentiated similarly to those of the true enamel organ. This is further substantiated by microincineration studies. Kronfeld has pointed out that . . . "for the formation of enamel, specialized mesodermic cells are necessary." It is imperative that a certain amount of dentin be deposited before amelogenesis can be initiated. Apparently the mesenchymal osteoid-like material furnished the stimulus necessary to activate the ameloblast-like cells of the neoplasm.

5. SOME OBSERVATIONS ON THE EFFECT OF SALIVARY GLAND EXTIRPATION IN THE RAT. *James T. Ginn, B.S., D.D.S., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* Rats 21 days old were placed on a milk diet fortified with Fe, Cu, and Mn, and grouped as follows: I. normal controls; II. sham operated, i.e., an incision was made but the salivary glands left in position; and III. operated, i.e., the major salivary glands removed. The ex-

perimental periods was the time required for the males to progress from 60 to 200 gms. and the females from 60 to 173 gms. The rate of growth of the desalivated animals was less than that of the other 2 groups, although the food consumption in the 3 groups was almost identical. This retardation in growth was more pronounced in the females than in the males. Basal metabolic rate studies failed to yield any conclusive evidence. The desalivated animals exhibited a rusting of the fur that is usually associated with a deficiency of vitamin B. This experiment raises the question as to whether or not the salivary glands have an endocrine function concerned with the promotion and regulation of growth.

6. THE ROLE OF EPITHELIUM IN BONE FORMATION. *Lester R. Cahn, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* For many years cases have been reported of epithelial tumors in which the epithelial element showed both calcification and definite new bone formation. According to Greig these cases prove that bone may form in the absence of osteoblasts and without their intervention. Several cysts and a cystic tumor are presented in which a bone-like substance appeared in the epithelial elements of the lesions. This substance seemed to be the result of epithelial secretion rather than a calcification of dead clusters of epithelial cells which is not unusual. This osseous material may be similar to the chondrin-like substance secreted by the epithelial cells of the mixed tumor, and which according to Simard and Masson is the forerunner of the cartilage found in mixed tumors.

7. OBSERVATIONS ON THE FORMATION OF CEMENTUM, PERIODONTAL MEMBRANE, AND BONE, 20 MONTHS POST-OPERATIVELY, WITH THE USE OF BOILED COW BONE POWDER. *Frank E. Beube, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* It was demonstrated, previously, on the 27th post-operative day, that new cementum, young connective tissue (periodontal membrane), and new bone, were being laid down over denuded dentin of dogs' teeth in the presence of boiled cow bone powder. Cellular activity and further organization of the above 3 tissues were continuing at this time, and even at 63 days. On the control side, without bone powder, only fibrous tissue was noted throughout the 27 day specimen; the 63 day control section also showed fibrous tissue throughout, no new bone, but there was laying down of new cementum, on one edge of denuded dentin. Findings are reported from tooth sections of animals permitted to survive 20 months after operation to learn changes after the above observations. The experimental area (bone powder inserted over denuded roots) in the 20 months specimen showed an increased thickness of cementum and denser bone than the earlier specimens with a well organized fibrous connective tissue (periodontal membrane) between these 2 structures. The new periodontal membrane was about twice as wide as the old in non-operated area. New fibres were curved, indicating lack of tension in the operated area. That portion of new cementum and new bone in contact with the new periodontal membrane was heavily blue stained from the hematoxilyn, indicating increased calcification. There did not appear to be any cellular activity at this time. The control area (without bone powder)

was essentially identical to experimental area, indicating that insertion of bone powder, hastened laying down of calcified structures.

8. Effects of congenital syphilis on jaws and tooth buds. *William H. Bauer, M.D., D.D.S., School of Dentistry, St. Louis University, St. Louis, Mo.* In jaws of children with congenital syphilis, *T. pallidum* were especially numerous around odontoblasts in the tooth buds, between cells of the united enamel epithelium, and in the dental sac. Numerous spirochetes were found imbedded in the predentin but the greatest number of organisms was observed adjacent to the united enamel epithelium which was occasionally coated with a dense layer of spirochetes. The organisms were widely disseminated in the basal part of the tooth buds, i.e., in areas of rapid growth. Characteristic spirochetes were always found in still borns while they were often absent in older known syphilitic infants. In these older infants the trepanomes had undergone degenerative changes and appeared granular, sometimes shorter and straightened with club ends. Debris, resembling precipitated stain, was observed in the soft tissue although the organisms around the osteocytes still retained their forms. Tissue changes appear in direct proportion to the numbers of spirochetes and, particularly, to their destruction. The masses of broken down organisms provoke syphilitic, exudative inflammation with small cell infiltration. It is logical to conclude that this inflammation resulted in detachment of the united enamel epithelium from the enamel, the destruction of parts of the ameloblasts which caused enamel hypoplasia and perhaps deformity of the teeth, as well as pulp changes. On the basis of these observations and the lack of evidence of endocrine effects the author rejects the idea of an endocrine genesis of the lesions of the teeth in congenital syphilis.

9. Reconsideration of the microscopy of the human dentin. *Wardlaw M. Hammond, Seymour Kreshover, D.D.S., and Lester W. Burket, D.D.S., M.D., School of Dentistry, University of Pennsylvania, Philadelphia, Pa.* This subject is approached from the standpoint of a microscopist. The study was undertaken because some of the photomicrographic resolutions in the literature, which are used to explain the text, do not appear to be true resolutions. By means of lantern slides, my interpretation (W. M. H.) of the tubules and fibres are demonstrated. Both stained and unstained sections of ground and decalcified sections as well as teased isolated fibres were studied.

10. Potential acidity and impermeability of spontaneously precipitated salivary mucin. *J. T. Gore, D.D.S., Philadelphia, Pa.* Evidence is presented that acid is formed by hydrolysis and fermentation of the carbohydrate component in mucin and that it is confined to the spontaneously precipitated gelatinous mucin precipitate when in contact with the supernatant liquid. Fifty cc. of partly stimulated saliva were collected at 0°C. in a flask containing 2 mgm. of bromcresol purple, agitating frequently. The solution was then divided into 2 equal parts: One was placed in a 50 cc. conical centrifuge tube, to the sides of which thymol had been fused to destroy acidogenic bacteria, and marked tube "A". The other half was placed in a similar tube, without thymol, and marked "B". Both tubes were incubated at 37°C. The supernatant

liquid in both tubes and the spontaneously precipitated mucin in tube "A" remained purple throughout the experiment. The precipitate in tube "B" changed from purple to light yellow in 8 hours, indicating a pH of about 5.4. The contrast of the color of the precipitate and supernatant liquid persisted more than 16 hours after the maximum was reached. pH determinations, with the Beckman meter, of the precipitate and supernatant liquid (separation without contamination being only partially successful), showed the supernatant liquid to have pH 7.02 and the precipitate pH 6.42. Twenty-two hours after placing in the incubator, the original whole saliva was at pH 7.20. (To be published in *J. D. Res.*)

11. PAGET'S DISEASE OF THE MANDIBLE AND MAXILLA. *Irving Glickman, B.S., D.M.D., Tufts College Dental School, Boston, Mass.* A histological study was made of the mandible and maxillae in 2 cases of Paget's disease in which these bones were involved. The findings in this study were compared with changes observed in these bones in non-Paget individuals of similar age group (50–65). The following observations regarding the mandible and maxilla were suggested by this limited comparison: All of the individual detailed histological changes observed in Paget's disease could be duplicated in the jaws of non-Paget individuals. Although Paget's disease is recognizable as a composite histological entity, it represents an alteration in severity and pattern, but not an alteration in the basic nature of the detailed histological changes which generally occur in the jaws in non-Paget individuals.

VI. SECOND SESSION: AFTERNOON, MARCH 14, ABSTRACTS 12–26

12. CORRELATION OF EARLY LOSS OF PERMANENT FIRST MOLAR TO SITE OF SECOND PREMOLAR ERUPTION. *J. A. Salzmann, D.D.S., New York City Vocational Schools, New York City.* Sequelae of permanent first molar extraction in the absence of subsequent orthodontic control of the direction, rate and amount of change of position occurring in the adjacent and other remaining teeth in the dental arches were studied in adolescent boys and girls nearing the final stage of tooth development. The rate and relative amount of closure of the space from which the permanent first molar had been extracted was determined for the maxilla and mandible. The difference in the rate and amount of shifting of the first and second premolars and second molars are determined for the maxilla and mandible. A correlation was made between the site of eruption of the second premolar and the dental developmental age at the time when the extraction of the permanent first molar occurred. (To be published in *J. D. Res.*)

13. OCCLUSAL CHANGES INDUCED BY EXPERIMENTAL INTERFERENCE WITH MASTICATORY MUSCLES. *Carl Breitner, M.D., D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Previous experimentation has shown that repositioning and reshaping of mandible can be accomplished artificially in young and adult *Macacus rhesus*, especially by artificial changes of vertical dimension. It has been suggested that in changing vertical dimension disturbed balance between protagonistic and antagonistic masticatory muscle

groups creates bone changes. If this is valid any other disturbance of that muscular balance must create corresponding results. Experiments based on this hypothesis, i.e., temporary paralysis of part of muscular apparatus creating open bite and prognathism within 2 months, have proven successful. Exact nature of bone changes has not yet been investigated but it is established that by influencing musculature it is possible to create changes in skull. Experimentally inducing dental and facial anomalies may lead to a better understanding of nature and origin of some facial deformities. Action on alveolar bone of force applied to tooth is modified by many factors, including important one of direction of application of force. Experimentally, relationship of certain force to degree and manner of its action can be established: A. Force applied in direction of longitudinal axis of tooth, or parallel to that axis (vertical force) causes least bone destruction. Bone resorption is seen in few areas where pressure had been created upon periodontal membrane, almost exclusively at apices and bifurcations. In all remaining areas pressure will be transformed into tension of the suspending fibers incuding new bone formation. B. Forces acting at angle to long axis of tooth (lateral forces) will always create large pressure areas and therefore induce extensive shifting of affected teeth. C. Combination of lateral and vertical forces proves most destructive to tooth-supporting apparatus. These facts are demonstrated in histologic material.

14. EFFECT OF EXTRACTION OF THE SECOND MOLAR ON THE MOVEMENT OF THE FIRST AND THIRD MOLARS IN RATS. *James T. Ginn, D.D.S. and Vernon H. Powell, D.D.S., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* The effect of extraction of the second molar on the movement of the first and third molar has been studied experimentally in 65 rats, divided into 6 groups. It was observed that: 1. The rate of closure of the mandibular diastema is greater than that of the maxilla. 2. The extraction of the second molar before the eruption of the third molar facilitates the rate of closure. 3. Bilateral extraction increases the rate of disappearance of the diastema created by the extraction of the second molar. 4. Interruption in the functional series of teeth in the rat is followed by drifting of the remaining teeth in an attempt to re-establish continuity within the series.

15. ROLE OF THE DENTAL PAPILLA IN EARLY TOOTH FORMATION: PART I. ROENTGENOGRAPHIC STUDY. *Harry H. Shapiro, D.M.D., W. Lefkowitz, D.D.S., and C. F. Bodecker, D.D.S., College of Physicians and Surgeons and School of Dental and Oral Surgery, Columbia University, New York City.* In order to study the influence of the developing dental papilla upon the differentiation of the other tooth components, the intact papilla in the teeth of young cats was removed through the apical region. The remaining portions of the developing tooth and its surroundings were observed for varying lengths of time by means of roentgenograms. Under ether anesthesia an incision was made on one side through the soft tissues overlying the border of the mandible, a window cut through the cortical bone with a surgical bur, the intact dental papilla, including the odontoblastic layer, was removed from the canine tooth on one side, and the wound sutured. The mandibular canine of the opposite side served as the

control in each case. Roentgenographic examination of 2 animals offers some evidence that absence of the dental papilla results in alteration of the eruption of the tooth, changes in calcification, and formation of new bone. A further report on the histological findings in these and additional animals is in progress. (To be published in *J. D. Res.*)

16. Some observations on the effect of cadmium on the dentition of the rat. *Peter Dale, D.M.D., James T. Ginn, D.D.S., and Joseph F. Volker, D.D.S., School of Medicine and Dentistry, University of Rochester, N. Y.* Preliminary to testing the efficacy of cadmium in reducing experimental caries in the rat, 4 groups containing 18 litter mates each were placed on a caries producing diet. Group I served as a control, Groups II, III and IV were maintained on the same diet but received supplements of 50 p.p.m. of cadmium in the food, 50 p.p.m. of cadmium in the water, and 50 p.p.m. of fluoride in the water, respectively. The findings of De Eds that small amounts of dietary cadmium are capable of producing a condition similar to or identical with mottled enamel and that there is a fall in the blood hemoglobin have been confirmed. It is possible that these findings are directly related. Weight curves indicate the growth of the cadmium fed animals (50 p.p.m. in food) approaches that of the normal. The effect of cadmium on the eruption rate of the incisor was discussed.

17. The "vitality" of the calcified dental tissues, v. protective metamorphosis in the dentin. *William Lefkowitz, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Protective metamorphosis has been described as a modification of the dentin occurring as a result of the aging process. It can only be observed by the examination of ground sections. Histologically one may observe diminution or arrest of the diffusion of dental lymph. This process increases the immunity of teeth to dental caries. An examination of 106 selected teeth shows that protective metamorphosis progresses from the crown to the apex of the tooth. The coronal dentin exhibits the change at 15 to 19 years after eruption. In the cervical third of the root it occurs at about 25 to 29 years of age and about 5 years later as the middle third. Protective metamorphosis was found to occur on crowned teeth in which the enamel was not removed and also in unerupted teeth. Preliminary examination of devitalized teeth demonstrates that the ageing process of dentin is arrested with loss of vitality of the tooth. (To be published in *J. D. Res.*)

18. Defects in contaminated amalgam. *Irl C. Schoonover, Ph.D., Wilmer Souder, Ph.D., and J. R. Beall, B.S., National Bureau Standards, Washington, D. C.* Excessive expansions, pits and blisters in amalgams, contaminated by perspiration or sodium chloride solutions during mixing, are shown to be the result of hydrogen gas liberated by a reaction within the restoration. This reaction appears to be independent of the media in which the specimen is kept. The effect has not been discovered in non-zinc alloys. The results emphasize the necessity of keeping the alloy and amalgam clean during the mixing and packing operations, rather than the selection of an alloy which, perchance, may conceal one of the defects resulting from contamination. Clean, condensed and

set amalgam specimens, placed in the salt solutions, do not exhibit these excessive expansions and blisters.

19. THE KNOOP INDENTATION HARDNESS INSTRUMENT AS A TOOL IN DENTAL RESEARCH. *W. T. Sweeney, A.B., Pittsburg, Pa.* This instrument developed by Knoop, Peters, and Emerson (*J. Research*, National Bureau of Standards, **23**: 39, 1939) has been used to measure the hardness of a wide range of materials to a high degree of accuracy. Hardness of dental materials such as gold alloys, dental cement, tooth structure, and resins have been measured. The application of this type of instrument in dental research was outlined. The refinement of the instrument so definite microscopic areas of a material can be subjected to a hardness test will be described. The results were illustrated by slides.

20. DOMESTIC WATER AND DENTAL CARIES. V. ADDITIONAL STUDIES OF THE RELATION OF FLUORIDE DOMESTIC WATERS TO DENTAL CARIES PREVALENCE IN 4425 WHITE CHILDREN, AGE 12–14 YEARS, OF 13 CITIES OF 4 STATES. *H. Trendley Dean, D.D.S., Francis A. Arnold, Jr., B.S., D.D.S. and Elias Elvove, M.S., Phar. D., Ph.D., National Institute of Health, U.S. Public Health Service, Bethesda, Md.* Study of the intensity of dental caries attack, as evidenced by observed dental caries experience, discloses striking differences among children of different cities. Including 2832 children of 8 suburban Chicago communities previously reported [*Pub. Health Rep.* **56**: 761, 1941], 7257 white urban school children, age 12–14 years, of 21 cities have now been studied; all children *continuously exposed throughout life to the variable under investigation* (common water supply). Clinical examinations in all 21 cities made by same dental officers and in each city equal number of children examined by each examiner. Such marked differences in dental caries prevalence not explainable on basis of hardness of domestic water, hours of sunshine, or gross dissimilarities in diet (water excluded). For cities studied amount of dental caries experience, permanent teeth, expressed as a rate (R) per 100 children examined, and mean fluoride concentration (F) of the public water supply expressed in parts per million were as follows: Galesburg, Ill., R. 236, F. 1.9; Colorado Springs, Colo., R. 246, F. 2.6; Elmhurst, Ill., R. 252, F. 1.8; Maywood, Ill., R. 258, F. 1.2; Aurora, Ill., R. 281, F. 1.2; East Moline, Ill., R. 303, F. 1.2; Joliet, Ill., R. 323, F. 1.3; Kewanee, Ill., R. 343, F. 0.9; Pueblo, Colo., R. 412, F. 0.6; Elgin, Ill., R. 444, F. 0.5; Marion, Ohio, R. 556, F. 0.4; Lima, Ohio, R. 652, F. 0.3; Evanston, Ill., R. 673, F. 0.0; Middletown, Ohio, R. 703, F. 0.2; Quincy, Ill., R. 706, F. 0.1; Oak Park, Ill., R. 722, F. 0.0; Zanesville, Ohio, R. 733, F. 0.2; Portsmouth, Ohio, R. 772, F. 0.1; Waukegan, Ill., R. 810, F. 0.0; Elkhart, Ind., R. 823, F. 0.1, and Michigan City, Ind., R. 1037, F. 0.1. Briefly, 847 children continuously using domestic water containing more than 1.4 p.p.m. of F. showed dental caries experience rate of 244; 1403 children of communities whose water supplies contained F. between 1.0 and 1.4 p.p.m. a prevalence rate of 294; in the 1140 children of cities whose public water supplies contained 0.5 to 0.9 p.p.m. of F., a rate of 416 was observed while the 3867 children of cities whose communal water contained less than 0.5 p.p.m. of F. showed a dental caries experience of 740 per 100 children examined. Unusually low dental

caries experience found associated with continued use of domestic water whose fluoride (F) content was as low as about 1.0 p.p.m. Under conditions prevailing in cities studied a F. concentration of this order produced only sporadic instances of the mildest types of dental fluorosis of no aesthetic significance. Fluoride (F) concentrations in domestic water between 0.0 and 1.0 p.p.m. apparently highly significant in epidemiology of dental caries. (To be published in *Public Health Rep.*)

21. DOMESTIC WATER AND DENTAL CARIES. IV. EFFECT OF INCREASING THE FLUORIDE CONTENT OF A COMMON WATER SUPPLY ON THE LACTOBACILLUS ACIDOPHILUS COUNTS OF THE SALIVA. *Francis A. Arnold, Jr., B.S., D.D.S., H. Trendley Dean, D.D.S. and Elias Elvove, M.S., Phar. D., Ph.D., National Institute of Health, U. S. Public Health Service, Bethesda, Md.* There are presented preliminary results obtained in a study of 109 public school children who have been exposed for about 2 years to a domestic water which has been increased in fluoride (F) content from about 0.1 to 0.7 ppm. A single clinical examination indicated that the dental caries experience rate of these children was similar to the rates reported in previous studies on children who were born and reared on domestic water which is practically free of fluorides. There is no indication according to the percentage distribution that the increased fluoride content of the water supply has as yet influenced the *L. acidophilus* counts. Such results might indicate that at least for the first 2 years increasing the fluoride content of a public water supply from 0.1 ppm. to approximately 0.7 ppm. would result in little, if any, decrease in caries activity of children whose teeth had calcified and had been exposed for a number of years to a water practically free of fluorides. However, the relatively unchanged *L. acidophilus* counts in this group may be the result of dental caries activity in lesions which had started prior to the change of water and were still active while subsequent clinical examinations may possibly show that fewer new carious lesions have developed since the introduction of the new water supply.

22. EFFECT OF DRYING ON BACTERIAL COUNTS OF ORAL MUCOUS MEMBRANES. *Lt. Cmdr. Carl August Schlack, DC. U. S. N., Lt (jg) Charles Davidson Hemphill, DC. U. S. N. and Lt. (jg) Donald N. Taylor, DC. U. S. N., U. S. Naval Dental School, Bethesda, Md.* Two oral areas were chosen for this study, 1. the mucosa near the gingival portion of the external alveolar plates between the canines of the maxillae and 2. the mucosa at the site of the injection for the mandibular dental nerve trunk near the inferior dental foramin. Number 1 area was studied on 50 patients. Number 2 area on 20 patients. Colony counts on number 1 area *wet* varied between 105 to 4288 with 80 per cent approximating the 4288 count and 20 per cent approximating the 105 count. Colony counts from number one area *dried* varied between 1152 and 0 with 20 per cent of the total counts approximating the 1152 count and 80 per cent approximating the count between 0 and 400. The average counts from the *wet* mucosa was 2599 and from the *dry* 339. Colony counts from number 2 area *dried* varied between 23 and 2304 with an average of 811. From the *wet* mucosa of this area colony counts ranged between 640 and 5568 with an average of 2357. Drying was done by air blast, only. (To be published in *J. D. Res.*)

23. DELAY OF DENTAL CARIES BY FLUORINE. *J. F. McClendon, Ph.D., W. C. Foster, M.S., N. Volney Ludwick, M.D. and J. Carl Criswell, D.D.S., Hahnemann Medical College and Hospital, Philadelphia, Pa.* The senior author (*Rock Products*, **26**: 77, 1923) found that 0.5–0.75 per cent fluor-apatite added to largely cereal diet of rats was beneficial to teeth. It has been claimed that this is toxic to animals, so experiments were repeated. Caries was produced on cereal diet of known fluorine content (0.3 parts per million). Caries appeared in 40 days and increased until there were 5 carious teeth per rat in 230 days. By adding 0.25, 0.5, 1 and 2 per cent fluor-apatite, diets were produced containing nearly 100, 200, 400, and 800 ppm. of fluorine, delaying caries but not more than the delay with 10 ppm. of fluorine in drinking water. Higher concentrations retarded growth of rats probably in part because 2 per cent fluor-apatite caused vitamin-A deficiency, possibly due to catalytic action of iron in fluor-apatite. To eliminate this effect fluor-apatite was not in the diet of another set of rats but used to brush their teeth, the rats swallowing it. At 87 days these rats had less caries than those without apatite had in 40 days. To further test toxicity, 2 of us brushed our teeth for 13 weeks with fluor-apatite and also ingested 2.5 grams of fluor-apatite (containing about 100 mg. fluorine) a day for 3 weeks. Since this had a slightly laxative effect dose was reduced to 1 gram per day (containing about 40 mg. fluorine) for 10 weeks longer. This increased urinary fluorine from 1 to 10 mg. per man per day but showed no certain effect in radiographs of bones. Increase of caries and alveolar bone resorption ceased and salivary calculus slightly decreased. Since fluorine content of bones of tea drinkers increases with age we analyzed tea grown in Georgia without fertilizer or insecticide and found it adds 3 ppm. of fluorine to that already in water used to make infusion.

24. PRELIMINARY REPORT ON THE EFFECT OF MECHANICAL INCREASE IN THE VERTICAL DIMENSION OF THE FACE IN ANGULAR CHEILOSIS. *Tom D. Spies, M.D., Arvin W. Mann, D.D.S. and F. Monette Springer, R.N., Hillman Hospital, Birmingham, Ala.* under *University of Cincinnati and University of Texas.* Eleven edentulous patients and 1 patient with a partial natural dentition were selected for study in Nutrition Clinic of Hillman Hospital, Birmingham, Alabama. All patients had history of angular cheilosis over several consecutive seasons but careful dietary and clinical studies indicated that their lesions were not due to riboflavin deficiency. Increasing the vertical dimension of the face in the edentulous patients was accomplished by relining the dentures temporarily with a commercial zinc oxide-eugenol paste. In order to effect an increased vertical dimension in the case with a natural dentition, methyl methacrylate resin splints were cemented temporarily over the teeth. Observations were made at frequent intervals during the season when angular cheilosis was most prevalent in this clinic. None of these patients was on a dietary treatment during the period of study. With an increased vertical dimension the moistness of these linear lesions at the corners of the mouth caused by the retention of saliva in these areas soon disappeared. A remission of the inflamed and ulcerated surfaces occurred and these patients complained less of soreness in these places. In all cases much improvement was observed although the lesions

had not completely disappeared. A recurrence of the patient's previous symptoms followed the removal of the relining material or splints. These observations should not be interpreted as evidence against that concept that cheilosis, in general, is frequently relieved by administration of riboflavin.

25. HEREDITY AMELOGENESIS IMPERFECTA. *Joseph P. Weinmann, M.D.* and *John F. Svoboda, B.S., D.D.S., Chicago College of Dental Surgery, Chicago, Ill.* Two families with "hereditary brown opalescent teeth" were investigated by radiographic and histological studies. It was shown that the anomaly in both families was a Mendelian dominant character and affected the deciduous as well as the permanent dentition. In respect to pathogenesis the 2 families differed distinctly. In one family crowns of the teeth of affected members were yellow-brown, smooth, glossy, hard and their shape resembled teeth prepared for jacket crowns. Histologically an abnormally thin layer of occasionally hypocalcified enamel was found over normal dentin. Enamel was covered with cementum and showed resorption. Large percentage of permanent teeth were embedded. "Hereditary generalized enamel hypoplasia" is an appropriate name for this condition since, primarily, the appositional function of ameloblasts is arrested prematurely. Crowns of teeth of affected members of the second family were dark brown, dull and rough. The enamel could be removed easily. Radiographically and histologically the amount of enamel formation was normal but it remained in the matrix stage. Dentin, pulp and cementum were normal. This anomaly, due to a disturbance in calcification of developing enamel, is called "hereditary enamel hypocalcification". Since both anomalies are characterized by deficiency in development of ectodermal constituents of the tooth, they should be termed "hereditary amelogenesis imperfecta" in contrast to "hereditary dentinogenesis imperfecta" in which disturbance only mesenchymal elements of the tooth are affected. The study of "hereditary brown opalescent teeth" showed that 2 stages of enamel development, formation and calcification, are distinguished, not only morphologically and chemically, but also pathologically.

26. EXPERIMENTAL ORAL SURGICAL PROCEDURES WITH COBALT-CHROMIUM-NICKEL AND COBALT-CHROMIUM ALLOYS. *Alvin E. Strock, D.M.D., Boston, Mass.* Metallic cobalt-chromium and nickel (Ticonium) and cobalt-chromium (Vitallium) have been placed in the maxillae and mandibles of animals and humans. These implants have consisted of the following: 1. Implants into the maxilla with one end of the implant projecting into the oral cavity for tooth replacement. 2. Mandibular implantation with projection into the oral cavity as attachment of appliance for reconstruction following resection of tumor. 3. Metallic implantation into the maxilla for reinforcement of teeth whose root formation is incomplete due to injury at the time of development. 4. Implantation for reinforcement of teeth weakened by root amputation. 5. Implantation for reinforcement of exfoliated teeth with root resorption.

VII. THIRD SESSION: EVENING, MARCH 14; ABSTRACTS 27–45

(A) DENTAL MATERIALS GROUP: ABSTRACTS 27–30

27. ELECTROGRAPHIC ANALYSIS OF DENTAL ALLOYS. *Joseph A. Calamari, Ph.D., Medical Laboratory, New York Medical Depot, U.S.A., New York.* In

the electrographic method of analysis, the metals and alloys are made active or passive and are dissolved anodically. The identity of metals is established by the color of the spot developed at the surface where the current enters a wad of electrolyte moistened filter paper. Qualitative tests for metals may be accomplished in 1 to 5 seconds. Quantitative tests, when adequate standards are available, are almost as rapid.

28. EXCESSIVE EXPANSION OF DENTAL AMALGAMS AND ITS RELATIONSHIP TO THE ZINC CONTENTS OF THE ALLOY. *E. O. Liebig, B.S.*, Newark, N. J. Results of interferometer tests for normal expansion and excessive expansion made on amalgams containing various amounts of zinc are as follows:

NORMAL EXPANSION OBTAINED BY PRECLUDING CONTAMINATION			EXCESSIVE EXPANSION OBTAINED BY CONTAMINATING THE AMALGAM WITH NaCl SOLUTION		
Zinc added	1 day	7 days	1 day	7 days	Difference
Per cent	*microns*		*microns*	*microns*	
1.5	8.2	*	1.1	137	+135.6
1.0	9.1	*	2.3	38	+36.0
0.6	8.5	*	7.4	22	+14.6
0.3	7.0	*	6.2	8.5	+2.3
0.2	6.7	*	6.0	5.8	−0.2
0.1	10.4	*	9.2	7.9	−0.3
Non zinc	11.2	*	13.0	12.0	−1.0

*No further change other than that due to temperature variation.

Excessive expansion can be eliminated in amalgams contaminated with chlorides by reducing the amount of zinc added to the alloy. Low zinc and non-zinc alloys tend to have poor working properties. Zinc properly added during the melting process definitely improves the properties of the alloy and therefore zinc should not be eliminated entirely but should be used in such quantities that whatever remains behind, after the scavenger action, is unable to produce excessive expansion. In order to evaluate the use of zinc as a modifier in dental alloy, we must first clearly define excessive expansion.

29. LONG CONTINUED EXPANSION OF AMALGAMS. *K. W. Ray, Ph.D.*, Minneapolis, Minn. A study of the effects of manufacturing processes and of dental technics on the expansion of zinc and non-zinc amalgams. The amount of expansion that occurs in amalgam specimens over a period of 1 year seems to depend to a large extent upon the composition of the alloy used, the technic of amalgamation and condensation used, and the environment of the specimen. The temperature and the length of time of annealing as well as the particle size of the alloy have a lesser influence.

30. BRINELL HARDNESS TESTING OF SYNTHETIC RESINS. *E. W. Skinner, Ph.D., and E. N. Cooper, B.S., Northwestern University Dental School, Chicago, Ill.* Weights of 12.6 kg., and 6.3 kg. were compared as to efficiency in obtaining Brinell impressions on 2 samples of Lucite, with the use of a micro-Brinell tester ($\frac{1}{16}$-inch ball). The specimens were allowed to remain under the various loadings for periods of time varying from 10 minutes to 6 hours. Diameter readings were obtained by the silhouette method, and, at periods of 30 to 60 minutes, on the impression after removing the load. The change in diameter under

constant load was found to be a logarithmic function of the time. The amount of diameter recovery was dependent on the load used, but was independent of the time of loading. When the 6.3 kg. weight was used, "unrecovered" diameters could be calculated from the impression diameters with a precision of 2 to 3 microns. The Brinell hardness values so obtained were accurate to within 0.2 unit, as checked by the silhouette method. A "skin effect" was noted during the first few minutes of loading; the ball at first caused a noticeable depression of the surrounding surface area before it "broke through" to produce the impression. These studies should be of value in connection with the surface plasticity of dental resins, and the effect of moisture, temperature, solvents, etc.

31. BACTERIOLOGICAL EVALUATION OF SOME SIMPLE STERILIZING METHODS. *Henry A. Bartels, B.S., D.D.S., and Elizabeth Rice, A.B., School of Dental and Oral Surgery, Columbia University, New York City.* The destruction of *B. subtilis* spores was the criterion employed in determining the efficiency of 5 simple methods of sterilization, namely, the flame, alcohol and the flame, formalin-alcohol and the flame, benzene-phenol-alcohol-boiling water, (each 30 seconds), and the Flaherty molten metal sterilizer. Small iron screws impregnated with *B. subtilis* spores, after exposure to 1 of the above methods, were dropped into tubes of broth which after 48 hours incubation were subcultured on infusion agar. The 5 methods were always tested in series, so one would be a control on the other. The results obtained were: 1. Passage 20 times through flame prevented growth of spores in 86 per cent of 15 screws tested, whereas passage 15 times restrained growth in only 6 per cent of 15 screws so tested. 2. Alcohol and the flame was effective in only 10 per cent of 30 screws tested. 3. Formalin-alcohol and the flame was effective in 92 per cent of 30 screws tested. 4. Benzene-phenol-alcohol and boiling water, each 30 seconds, was effective in only 15 per cent of 30 screws tested. 5. Molten metal was effective in 91 per cent of 68 screws tested.

32. INCIDENCE OF FUSOSPIROCHETAL ORGANISMS IN THE EDENTULOUS MOUTH. *S. Leonard Rosenthal, D.D.S. and Edward H. Gootzeit, B.A., School of Dentistry, University of Pennsylvania, Philadelphia, Pa.* Contrary to accepted statements, oral spirochetes and fusiform bacilli are found in the mucosa of edentulous patients. Examination of 200 healthy adults revealed small numbers of these organisms. There is a marked decrease in the number of all types of bacteria. (To be published in *J. D. Res.*)

33. CULTIVATION OF SPIROCHETES OF THE MOUTH. *Theodor Rosebury, D.D.S., and Genevieve Foley, M.A., Medical and Dental Schools, Columbia University, New York.* Using the method previously described by the authors (*Proc. Soc. Exp. Biol. & Med.* **47**: 368, 1941) with further improvements, it has been possible repeatedly to isolate 2 or more varieties of spirochetes from fuso-spirochetal processes of the mouth and other areas, as well as from exudates from guinea pig lesions originally produced with human lesion material. Characteristic spirochetal growth, in primary cultures in small plates of serum ultrafiltrate-infusion agar containing fresh sterile minced guinea pig kidney, is transferred to 12 x 200 mm. test tubes containing a 12-cm. column of the same agar with a single piece of sterile guinea pig kidney. Transfers are made with capillary

pipettes in such a way as to avoid introducing air with the inoculum. The tall tubes may be incubated aerobically, reducing conditions being sufficiently intense near the fresh tissue to permit growth even of the more fastidious anaerobes. Pure cultures of spirochetes transferred about every 2 weeks grow readily and abundantly under these conditions. Morphologically at least 2 varieties of spirochetes can be distinguished: a tightly wound form corresponding with descriptions of *Treponema microdentium*, and a small, more loosely wound spirochete with only 3 to 5 turns, not clearly corresponding with any spirochete hitherto described. These studies are being continued.

34. COMPARATIVE INFECTIVITY FOR GUINEA PIGS OF FUSO-SPIROCHETAL EXUDATES FROM DIFFERENT MOUTH DISEASES. *Genevieve Foley, M.A. and Theodor Rosebury, D.D.S., Medical and Dental Schools, Columbia University, New York City.* Typical fuso-spirochetal organisms are found by darkfield examination in several distinct inflammatory diseases of the gingival and periodontal tissues. Gingival scrapings from any of these diseases are able to initiate typical fuso-spirochetal lesions in guinea pigs by subcutaneous inoculation. The following data indicate the comparative infectivity of human lesion material from the different sources. Heavy suspensions of gingival scrapings in 1 cc. of broth were obtained from 105 clinic patients. Each suspension was checked by darkfield examination and about 0.5 cc. of each of 64 suspensions was injected subcutaneously into the groin of a guinea pig (Rosebury and Foley, *J. A. D. A.* **26**: 1798, 1939). Development, usually within 10 days, of a necrotic abscess or cellulitis with aspirable exudate containing numerous spirochetes and other organisms of the fuso-spirochetal flora was considered a positive response. Such positive responses were obtained from: 17 of 29 injected specimens from acute Vincent's infection (59 per cent); 16 of 25 from periodontoclasia (64 per cent); 5 of 6 from marginal gingivitis (83 per cent); and 2 of 4 from infected third molar flaps. No differences in character of the animal lesions or in the flora of their exudates could be correlated with source of infection. These results indicate that exudates from the 4 diseases do not differ significantly in infectivity for the guinea pig. (To be published in *J. D. Res.*)

35. ANTIBODY FORMATION IN THE REGIONAL LYMPH NODE IN INFLAMMATION. *W. E. Ehrich, M.D. and T. N. Harris, M.D., School of Medicine, University of Pennsylvania, Philadelphia, Pa.* The formation of hemolysins and agglutinins following subcutaneous injection of sheep erythrocytes and typhoid vaccine and the simultaneous changes in the efferent lymph and the morphologic structure of the regional lymph node have been studied experimentally in rabbits. It has been found that the formation of antibodies in this node started on the 2nd to 3rd day, to reach its maximum on the 6th day, and this was preceded and accompanied by marked lymphatic hyperplasia and outpouring of large numbers of lymphocytes through the efferent lymph; while the reticuloendothelial system showed little reaction. These results point to the lymphocytes as an important factor in the formation of antibodies.

36. SOURCE OF BACTERIA EJECTED INTO AIR BY SNEEZING. *J. L. T. Appleton, D.D.S., Sc.D., and Anne K. Dietz, School of Dentistry, University of Pennsylvania, Philadelphia, Pa.* A suspension of *Serratia marcescens* was sprayed

into each nostril, and a sneeze induced by inhaling powdered dry cigaret tobacco or Copenhagen snuff. At instant of sneeze, petri dish (diam. 14 cm.), containing steril, solid, nutrient agar was held 6″ to 8″ at such an angle that the agar would intercept most of ejected material. Immediately following this sneeze #1, the subject's mouth was sprayed with the bacterial suspension. A second sneeze (#2) was induced and a petri plate used to intercept, similarily, the ejected material. Three controls were made:—1. Before introducing the bacteria into the nostrils, the mouth was rinsed and this rinse examined for the test bacterium. 2. Immediately after inoculating the nasal mucosa, the material sprayed from the nebulizer was collected on the surface of an agar plate to ascertain if the test organism was actually sprayed into the nose and if conditions of incubation were favorable for development of pigment by which organism was identified. 3. A nutrient agar plate was exposed to the air in the room in which subject sneezed, at same time that he was sneezing and for a slightly longer period to eliminate the question of air contamination. On one subject the #1 sneeze plates (nose inoculated) were positive twice, negative 14 times; the #2 sneeze plates (mouth inoculated) were positive 12 times, negative 4 times; 16 mouth rinse controls were negative, 16 nebulizer controls positive and 16 air controls negative.

37. NUTRITIONAL REQUIREMENTS OF ORAL LACTOBACILLI. I. PANTOTHENIC ACID AND DEXTROSE (D-GLUCOSE). *Thomas J. Hill, D.D.S., and Albert H. Kniesner, B.S., D.D.S., School of Dentistry and Institute of Pathology, Western Reserve University, Cleveland, O.* In order to arrive at a fuller understanding of the factors which may govern the number of oral lactobacilli in saliva, a study of the nutritional requirements of these bacteria was undertaken. Pantothenic acid, one of the filtrate factors of the vitamin B complex, is a requirement for growth of oral lactobacilli. It is present in human saliva in quantities ranging from 0.012 to 0.19 micrograms per milliliter of saliva. Dextrose is also an essential for growth. The dextrose content of saliva depends largely on the patient's diet except in extreme cases of hyperglycemia. Growth response to increments of calcium pantothenate and dextrose was recorded by measuring the quantity of titratable acid produced. Curves were plotted to show strain variations in growth among the common types of lactobacilli isolated from the mouth.

38. BLOOD STUDIES IN PERIODONTOCLASIA. *Benjamin Tenenbaum, B.S., D.D.S., and Maxwell Karshan, Ph.D., Dental and Medical Schools, Columbia University, New York.* Blood was analyzed in a group of 45 patients, 20 to 61 years of age, having advanced periodontoclasia. Ten were calculus-free; 35 had heavy deposits of calculus. Analyses were made immediately before all their remaining teeth—at least 12—were extracted. In 20 cases, analyses were repeated after all extractions were made and gingiva had healed. Mean values before extraction: total serum calcium, 10.7; serum inorganic phosphate, 3.1; plasma cholesterol, 211; plasma vitamin C, 0.95; blood sugar, 91; blood uric acid, 2.9—all in mg. per cent; serum protein 6.4 per cent; serum phosphatase, 3.1 Bodansky units; plasma carbon dioxide capacity, 61.8 volumes per cent. Of the 45 cases, 10 gave normal blood pictures. In 35 cases which gave one or more values outside normal ranges, 5 calcium, 11 phosphatase and 11 choles-

terol values were above upper limit of usually accepted normal ranges (240 for cholesterol). Thirteen vitamin C values were below 0.7, regarded by many as low limit of normal. Values for other constituents were, in general, in normal ranges. Deviations from normal in 1 or more characteristics were found in 6 of the 10 calculus-free cases, and in 29 of the 35 calculus cases. In the 20 cases where analyses were repeated after extraction of teeth, clearing up of infection and healing of alveolar bone and gingiva, 18 had values which deviated from normal in 1 or more respects in initial analysis. In 11 of these cases deviations from normal range were found again after extraction of the teeth, while in the remaining 7 cases normal values were obtained after extraction.

39. SALIVARY STUDIES IN PERIODONTOCLASIA. *Benjamin Tenenbaum, B.S., D.D.S. and Maxwell Karshan, Ph.D., Dental and Medical Schools, Columbia University, New York.* Saliva was analyzed in a group of 38 patients, 20 to 61 years of age, having advanced periodontoclasia (same cases on which blood study was made: abstract 38). Analyses were made before teeth were extracted. Ten cases were calculus-free; 28 had heavy deposits of calculus. Results:

Mean values for saliva in calculus-free and calculus groups

	TYPE OF CASE	Ca	INORG. P	PROTEIN	INITIAL* pH	FINAL†	CO_2 COMBINING POWER	TIME FOR COLLECTION OF 10 CC. OF SALIVA
		mg. per 100 cc.					cc. per 100 cc.	
Unstimulated Saliva	Calculus-free	5.6	17.5	383	6.65	6.86	6.8	34.5
	Calculus	7.0	19.7	394	6.54	6.91	7.6	30.4
Stimulated Saliva	Calculus-free	5.2	11.3	280	7.20	7.49	29.6	8.9
	Calculus	6.8	13.5	301	7.20	7.46	29.1	9.0

* Determination on first portion of saliva collected.
† Determination on last portion of saliva collected.

The results for calcium and phosphorus confirm our previous findings for calculus-free and calculus groups (*J. A. D. A.*, **26:** 1965, 1939). Mean values in advanced periodontoclasia without calculus were similar to those in group free from this disease and from calculus as previously found. Mean values in advanced periodontoclasia with heavy deposits were similar to those previously found in group having heavy deposits either without periodontoclasia or with slight or moderate degrees of periodontoclasia.

40. RELATIVE ALVEOLOCLASTIC EXPERIENCE OF THE VARIOUS TEETH. *Samuel Charles Miller, D.D.S., and Benjamin B. Seidler, A.B., D.D.S., College of Dentistry, New York University, New York.* The relative amount of bone loss seen in the radiographs of patients treated in the periodontia clinic was recorded. Five hundred cases, selected at random, were studied. Ages ranged from 14 to 70 years; mean was 39.8 years. Each tooth was given an alveoloclasia number ranging from 0 to 5 depending upon the relative visible amount of bone loss. The average alveoloclasia indices of the various teeth (determined by dividing the sum of the alveoloclasia numbers by the total number of such remaining

erupted teeth) tended to fall into 4 broad categories of relative susceptibility. In order of increasing susceptibility, these were: Group I. Maxillary and mandibular first and second premolars and canines and the mandibular third molars. Group II. Mandibular first and second molars. Group III. Maxillary first and second incisors and third molars and left first and second molars. Group IV. Maxillary right first and second molars and mandibular first and second incisors. (To be published in *J. D. Res.*)

41. DENTAL CONDITIONS OF INDIANA UNIVERSITY FRESHMAN STUDENTS. *Harry J. Healey, B.A., D.D.S. and Virgil D. Cheyne, D.D.S., Ph.D., Indiana University School of Dentistry, Indianapolis, Ind.* Analysis of caries experience of all Freshman students entering the University of Indiana in 1940–41 was made. Examinations were conducted by experienced dentists with adequate artificial light using a good dental mirror, a sharp explorer and a chip blower. Experienced assistants recorded the observations. A total of 3,234 students (1,003 females; 2,231 males) were examined. The average age of females was 18.67 years; males, 19.23 years. Similar study at University of Minnesota in 1939 included 4,348 (1,671, females; 2,677 males) with closely comparing age averages. Data on caries experience were compiled by tabulating actively carious teeth, teeth with fillings, and extracted teeth. Third molars were excluded from the compilations. An analysis showed that the number of perfect mouths (104) at the University of Indiana exceeded those at the University of Minnesota (51) by 2.05 per cent. The total average number of affected teeth per person at Indiana was 10.12 compared with 11.08. The females possessed 3.12 per cent more unaffected teeth than did the corresponding group at Minnesota; the male group possessed 3.31 per cent more unaffected teeth. The variation in susceptibility to caries in the several morphological types of permanent teeth was similar at both universities. The decreasing order of susceptibility can be shown by the following grouping: Group 1, mandibular and maxillary first molars; Group 2, mandibular and maxillary second molars; Group 3, maxillary second premolars; Group 4, maxillary first premolars and mandibular second premolars; Group 5, maxillary first and second incisors; Group 6, maxillary canines and mandibular first premolars; Group 7, mandibular first and second incisors and mandibular canines.

42. PRELIMINARY REPORT ON THE CONDITION OF THE TEETH AND THE ATTACHMENT APPARATUS IN TUBERCULOSIS. *Irving E. Gruber, D.D.S., Sea View Hospital, New York.* Opinions regarding possible changes in the dental apparatus in tuberculous individuals are divergent. Some believe there is a direct relationship between the condition of the teeth and attachment apparatus and tuberculous infection and that cervical cavities and gingivitis are characteristic of this disease. The present study was undertaken to determine the validity of this statement. The hard and soft tissues in 69 adults with tuberculosis were studied and the findings correlated with the data obtained from similar reported studies. Periodontal disease was not found more often in tuberculous than in non-tuberculous individuals. There was more periodontal involvement in males than in females. The class V or cervical cavity was not characteristic of the tuberculous patients examined. Tuberculous males showed not only a

higher incidence of carious teeth, but also a higher incidence of cavities than females. The total caries experience of the individuals, measured in terms of DMF was higher in males than in females. The DMF value obtained indicated only a slightly higher incidence of tooth defects in tuberculous patients than in supposedly healthy individuals. No conclusions were made because too few cases were examined.

43. APPLICATION AND ACTION OF OXYGEN IN THE GINGIVAL POCKET. *B. Orban, M.D., D.D.S., Chicago College of Dental Surgery, Chicago, Ill.* Oxygen can be applied in the gingival crevice in the form of undiluted 30 per cent hydrogen peroxide (Superoxol, Merck), neutralized before use by adding 1 drop of a 5 per cent bicarbonate of soda solution to 10 or less drops of the drug. The solution is taken up by a few cotton fibers which are carried into the gingival crevice by means of a flat instrument. The tissue catalase liberates oxygen from the peroxide. Oxygen penetrates through the epithelium into the connective tissue in innumerable bubbles. The action of the hydrogen peroxide is painless, causing only a slight burning sensation, and no sloughing of the tissue results. The application is repeated until the tissue turns white due to compression of the capillaries. In 15–20 minutes the whiteness disappears. If the application of the solution is repeated twice a week for a period of 6 to 10 weeks, the chronic inflammation of the gingiva subsides. Microscopically the plasma cells in the connective tissue show degeneration and finally disappear. Eosinophils become more numerous. The tissue becomes fibrous in character. The epithelium shows very marked peg formation with extremely numerous mitotic figures. Hornification on the surface is more intensive than before treatment. The conclusion seems to be that oxygen medication is a favorable aid in combating chronic gingival inflammation and stimulating tissue regeneration.

44. CONDUCTION OF SOUND THROUGH THE HEAD DURING DENTAL OPERATION. *Samuel Rabkin, D.D.S., Cincinnati, O.* Two factors are responsible for conduction of sound through the patient's head during dental operation, variable bone formation among different individuals and improper instrumentation. Sound is transmitted through the pneumatic chambers of the head. The thinner and more porous the bone, the more intense is the resonant amplification during tooth preparation. While methods employed in operative dentistry make it impossible to eliminate entirely the objectionable excessive and distracting conduction of sound, it is mostly due to improperly designed, cumbersome and coarse grinding instruments. Especially objectionable is the sound caused by large caliber burrs and overly-coarse stones. Light weight hand pieces, small caliber good quality burrs, finer grit stones or diamond points and covering with oil during use greatly reduce the sound. A detailed study of variations of bone formations of the head suggest that intensity of sound can have different effects on patients. Tests were made on a skull, with a large moist sponge sealed within the vault and a heavy layer of wax replacing the outer soft tissue, using an assortment of burrs and stones, dry and moist, (water and oil) and also varying the degree of speed and pressure on instruments. The skull was placed on a cushioned stand and phonograph recordings with both stand and contact microphones made when teeth were cut. Using a "decibel" meter, a graph was

made from the record revealing the contrasts between type of instrument and technique employed. Tests were made to determine the effects of the length and weight of the "standardized" hand pieces as they contribute toward the comfort or discomfort during operations.

45. Preliminary report on the use of sodium fluoride applications in caries prophylaxis. *B. G. Bibby, D.D.S., Ph.D., Tufts Dental School, Boston, Mass.* Between January 1941 and February 1942 during the first year of a projected 3-year study, 3 applications of 1/1000 sodium fluoride were made at approximately 4-month intervals on the teeth in 1 quadrant of mouths of 100 unselected children, aged 10 to 13 years. Two to 24 hours prior to each fluoride treatment all teeth were given routine prophylaxis by a dental hygienist. Fluoride treatment consisted of cleaning teeth with hydrogen peroxide, isolating the test side with cotton rolls, dehydrating with alcohol, and keeping all surfaces of teeth wet with sodium fluoride for 7 or 8 minutes by means of repeated applications with cotton swabs. Various quadrants were treated in different mouths and to minimize possible differences from patient to patient, variations in susceptibility, diet, etc. the corresponding quadrant on the opposite side of each mouth was used as control. Examinations with mirror and explorer were made at an interval of approximately 1 year, before the first and fourth fluoride treatment. Only findings on permanent teeth were compared. These revealed that in 89 patients completing the first year a number of affected (carious, filled or extracted) surfaces in the 494 permanent teeth in the treated quadrants had increased by 95, from 211 to 306, and in the 490 teeth in the untreated control quadrants by 135, from 223 to 358. The principal difference noted is in the amount of new caries between the treated and control sides, 60 cavities appearing in the control and 33 in the treated quadrants. These preliminary results seem to justify the expansion of this type of study and the preliminary usage of sodium fluoride as an adjunct to dental prophylaxis.

VIII. Fourth Session: Morning, March 15; Abstracts 46–58

46. Prevention of dental caries by massive doses of vitamin D. *Ralph Howard Brodsky, D.M.D., Bela Schick, M.D. and Hermann Vollmer, M.D., Sea View and Mt. Sinai Hospitals, New York.* A group of 200 children (for 101 of whom data are reported in this paper) who had tuberculosis or had been in contact with a patient with the disease were studied carefully for period of approximately one year in Sea View Hospital to determine effect of a single massive dose of vitamin D on incidence of dental caries. A control group received only hospital diet, devoid of cod liver oil or any other additional source of vitamin D; a second group received, in addition to the hospital diet, 305,000 U.S.P. units of vitamin D and 2,455,000 U.S.P. units of vitamin A in 30 cc. of fish liver oil concentrate, and a third group received 600,000 U.S.P. units of vitamin D in the form of crystalline vitamin D in 1 cc. of oil in addition to the same hospital diet. In the control group 39 cavities (1.18 new cavities per child) developed during the observation period. In the second group 13 cavities (0.39 cavity per child) and in the third group 6 cavities (0.17 cavity per child)

developed. None of the children showed any toxic manifestation after the administration of the single massive dose of vitamin D. Further studies are required, on larger groups. However, results of this study seem to indicate that the incidence of dental caries may be markedly decreased by administration of a single massive dose of vitamin D. (Published in *Am. J. Dis. Child.*, **62**: 1183, 1941.)

47. QUANTITATIVE METHOD FOR EVALUATING EFFECTIVENESS OF PHYSICAL AND CHEMICAL AGENTS WHICH MODIFY HYDROGEN ION CONCENTRATIONS ON TOOTH SURFACES. OBSERVATIONS ON EFFECTS OF SYNTHETIC DETERGENTS AND UREA. *Robert M. Stephan, M.S., D.D.S. and Benjamin F. Miller, B.S., Ch.E., M.D., Walter G. Zoller Memorial Dental Clinic and the Department of Medicine, University of Chicago, Chicago, Ill.* The pH of bacterial deposits on accessible tooth surfaces and carious areas may be determined frequently in same area *in situ* by antimony electrode method without destroying bacterial deposit. Characteristic pH curve is obtained when teeth are rinsed with solution of 10 per cent glucose; in general, there is sharp drop in pH within few minutes after application of carbohydrate, and return to original pH within 30 to 60 minutes. As soon as pH has returned to original value repetition of pH determination after glucose rinse gives same type of curve. Areas under 2 curves duplicate each other to within 10 per cent in almost every experiment. To study influence of compounds which modify pH changes on tooth surfaces above method is employed by applying test solutions before second glucose rinse. Reduction of area under curve obtained after application of test solution gives measure of its effectiveness in preventing pH drop produced by administration of glucose. Inhibitory effects of antibacterial, synthetic detergents on drop in pH after glucose is found to be influenced by thickness of bacterial deposit, concentration of solutions, and time of application of compound. This method has shown that applications of urea to tooth surface can counteract acid produced from carbohydrates. In addition, we have found that concentrated urea solutions appear to exert definite inhibitory effect on production of acid by surface flora of teeth.

48. FACTORS INFLUENCING THE INHIBITORY EFFECTS OF SYNTHETIC DETERGENTS AND UREA ON DENTAL PLAQUE MATERIAL. *John A. Muntz, A.B., M.S., Walter G. Zoller Memorial Dental Clinic, University of Chicago, Chicago, Ill.* Some synthetic detergents at concentrations as low as 1:30,000 will prevent completely the formation of acid from carbohydrates by *homogenized* dental plaque material. However, much higher concentrations of these compounds do not inhibit entirely production of acid by *intact* plaques. In order to study some of the factors which determine rate of penetration of inhibitory compounds into intact plaques, a method was devised whereby artificial plaques of known thickness could be prepared. Varying amounts of a homogenized plaque suspension are centrifuged in hematocrit tubes and mats of plaque material which vary from 0.2 to 2.0 mm. in thickness are laid down. The inhibitory compounds are layered over these "plaques," and later removed by washing. Ability of the plaques to decompose glucose following such exposure was determined.

Degree of inhibition produced in this way by anti-bacterial synthetic detergents and by urea was found to be a function of (a) thickness of the plaque, (b) concentration of inhibitory compound, and (c) length of time of exposure to the inhibitor. The experiments indicate that concentration of inhibitor is of great importance in providing adequate diffusion into the plaques in a length of time which might be feasible to use in oral prophylaxis. This technic has been employed for detailed investigations of the ability of synthetic detergents and urea to prevent production of acid by dental plaque substance.

49. STUDIES ON PRODUCTION OF HYPERSENSITIVITY IN RABBITS BY INJECTION OF ORAL LACTOBACILLI. *Ned B. Williams, D.D.S., Walter G. Zoller Memorial Dental Clinic, University of Chicago, Chicago, Ill.* Heat killed vaccines prepared from lactobacilli of human oral origin were used for sensitization of rabbits. Intradermal injection of $\frac{1}{10}$ cc. of vaccine produced a small, slightly raised, hyperemic nodule which first appeared after 10 to 12 hours. The lesion reached its maximal intensity in 48 hours and had largely receded in 6 to 9 days. Repeated intradermal injections of the vaccine resulted in lesions of increasingly greater size and intensity, appearing sooner than initial reaction to vaccine, usually becoming necrotic and often suppurative, and persisting for several weeks. Peak of skin reactivity was reached after 4 to 6 successive intradermal injections, and subsequent reactions were progressively diminished in size, intensity, and duration. Bacterial carbohydrate substance obtained from suspensions of the lactobacillus organisms by extraction with hot dilute hydrochloric acid and purified by repeated alcohol precipitations reacted in high dilution with serum from rabbits immunized by intravenous injection of homologous vaccines. Intradermal injection of purified carbohydrate extract of oral lactobacilli into animals previously sensitized by repeated intradermal inoculation of homologous vaccine resulted in delayed skin reaction, indicative of hypersensitive state. Injection of several skin different purified bacterial extracts into separate sites of skin of such sensitized animal resulted in some positive and some negative reactions. By means of skin reactions to carbohydrate substances it was possible to differentiate lactobacilli tested thus far into 2 broad groups. Findings suggest that sensitized state may be used in study of interrelationships of oral lactobacilli, may provide firmer basis for classification and differentiation and that this skin test may be used in study of association of lactobacilli with dental caries.

50. COLCHICINE METHOD AS APPLIED TO PROBLEMS OF GROWTH IN DENTAL TISSUES. *Ellis B. Jump, A.B., D.M.D., Walter G. Zoller Memorial Dental Clinic, University of Chicago, Chicago, Ill.* The alkaloid, colchicine, has a generalized arresting effect on all cells having karyokinetic potentiality. Following subcutaneous injection of an aqueous solution of the drug, all cells which initiate division continue only as far as metakinesis (pre-metaphase) before being blocked. Sections, prepared at any time before recovery commences at 9 to 12 hours after injection, will contain enormous numbers of mitotic figures which represent practically all cells which had begun to divide in interval since administration of the drug. A variable degree of pyknosis and karyorrhexis

is associated with the arrested mitoses. Although previously this method has been applied to tumor tissue or artificially stimulated genital or endocrine epithelia, Harry Sicher and the author, working independently, have applied colchicine to study of teeth of continuous eruption. The method is not difficult to use and reveals clearly the growth centers of cell division in developing teeth. However, there are many variables which should be controlled for each species. In order to obtain the maximum colchicine blockade with a minimum of toxic changes, it is recommended that in the rat a dose of 1.2 to 1.4 mgm./kilo of body weight in aqueous solution be given s.c. and the animal sacrificed 10 to 12 hours later.

51. SOME NEW ASPECTS IN PATHOLOGY OF DENTAL CARIES. *B. Gottlieb, M.D. and E. Hinds, College of Dentistry, Baylor University, Dallas, Texas.* The beginning of caries as well as its progress is apparently a process of invasion of microorganisms into suitable organic matter. Two groups of microorganisms seem to cooperate in producing caries, a proteolytic group producing a yellow pigment and an acidogenic group showing up as acid action (in enamel, transverse striation; in dentin, shrinkage). If microorganisms invade the uncalcified sheaths of the prisms *frontal caries* results with the greatest extent at the surface. In many cases the progress stops somewhere in the enamel because of failure to reach dentin or tufts and lack of sufficient nourishment in the enamel. In such cases, no clinical caries develops. Thus, microscopically arrested enamel caries occurs. If frontal caries reaches dentin or tufts of the enamel undermining caries develops. If microorganisms invade a lamella which goes to the dentin, the proteolytic group moves fast along the lamella towards dentin and reaching the dentin, starts *undermining caries*. On the anatomical root, only frontal caries develops; on the cemento-enamel junction, undermining caries. If these roads of organic matter are poisoned by thorough impregnation of the surface of the clinical crown with "Septochem" (Compound of silver nitrate and calcium chloride or silver nitrate and indigosol. Rosenzweig Chemical Corp., New York City) having a great bactericidal action, the acidophilus counts are considerably reduced, often to zero. Observations for 6 months showed these results.

52. DIFFERENCES IN RESISTANCE TO DENTAL CARIES. *E. Hinds, B.A., D.D.S., Baylor Dental College, Dallas, Texas.* Caries seems to start by invasion of microorganisms into organic matter of the tooth, the lamellae and uncalcified prism sheaths of the enamel, and the cementum. If the prism sheath is also calcified the resulting transparent enamel may resist the invasion of microorganisms. The permeability of these organic paths for the carious process and silver nitrate seem to be the same. Thus the spreading of the process can be illustrated by impregnating teeth with silver nitrate and making ground sections. After 5 minutes impregnation, some lamellae carried the silver nitrate to the dentin producing a black spot at the entrance of the lamellae. Many other lamellae do not show even a black staining of the lamellae themselves. The same applies to the smaller organic paths of prism sheaths, where areas of transparent enamel show no penetration of silver nitrate. Thus there are 2 dif-

ferent kinds of resistance of the enamel against invasion of microorganisms. While transparent enamel means apparent resistance to invasion into the sheaths of the prisms, the failure of $AgNO_3$ to penetrate some lamellae while others in the neighborhood are penetrated seems to indicate that the permeability of some lamellae is different from that of others. No statement can be made about the operation of the obstruction. (To be published in *J. D. Res.*)

53. FORM OF THE CONTACT SURFACES AND THEIR RELATIONSHIP TO CARIES SUSCEPTIBILITY. *F. W. Hinds, D.D.S., College of Dentistry, Baylor University, Dallas, Texas.* It is apparent from the observation and statements of the majority of investigators that the typical tooth upon eruption is rounded or convex at the surface of the tooth that makes proximal contact with adjoining or proximal teeth. It is assumed that in newly erupted teeth the proximal surfaces have a marble like contact that we designate as a contact point. Apparently, immediately after eruption wear starts due to friction at the contact surface caused by the continued movement of the teeth in their sockets. It is generally known that worn or flat planes are found. A microscopic study of the contact surfaces prove that concave surfaces caused by friction from the adjoining tooth are often present, proving that the contact surface of one tooth may be more resistant to wear than the contact surface of an adjoining tooth. It is a generally accepted theory that caries usually starts below the contact point when no plane exists, but as soon as the plane or the concave surface is formed frontal or undermining caries can start on the worn surface. The statement that the friction caused by the rubbing of the contact surfaces prevents caries is not always true. It is apparent that retention alone cannot cause caries and rubbing or friction of the contact surfaces cannot assure prevention of caries. (To be published in *J. D. Res.*)

54. POSSIBLE SIGNIFICANCE OF STREPTOCOCCI IN THE PRODUCTION OF DENTAL CARIES. *Hazel I. Tefft, A.B., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* Four hundred and thirty-eight strains of nonhemolytic streptococci isolated from human mouths were tested and classified according to the method of Sherman. Two hundred and twenty were classed as *Streptococcus salivarius*, 110 as *Streptococcus fecalis*, and 108 as *Streptococcus lactis*. Biochemical tests were carried out on 92 strains. That oral streptococci are significant in dental caries is indicated by the acidogenic ability of *Streptococcus fecalis* and by the large numbers of *Streptococcus fecalis* and *Streptococcus lactis* found in caries.

55. FORMATION OF SECONDARY DENTIN IN HUMAN CARIOUS TEETH. *Sidney Benzer, B.S. and Gerrit Bevelander, Ph.D., New York University, College of Dentistry, New York.* In the examination of a series of human mature carious teeth 2 main types of secondary dentin was identified: 'physiological', and 'pathological.' The former tissue is present in all of the permanent teeth examined and is located on the peripheral margin of the pulp cavity. An analysis of the incidence and variety of 'pathological' secondary dentin which occurs in these specimens is as follows: 1. In 77 carious lesions examined, 'pathological' secondary dentin occurs in only 56 per cent of the total number of specimens.

2. The different varieties of this tissue were observed to be (a) clear irregular (60 per cent), (b) dense irregular (22 per cent) and miscellaneous varieties (18 per cent). 3. Pathological secondary dentin in this series occurs in 80 per cent of the anterior teeth, 56 per cent of the premolars, and 42 per cent of the molars. 4. Clear irregular secondary dentin occurs more frequently in the anteriors and premolars than in the molars in the ratio of approximately 8 to 2. The dense irregular variety, however, occurs most frequently in the molars. 5. When the incidence of secondary dentin is examined in reference to the relative depth of the lesion, we find that the deep, medium, and shallow lesions reveal the presence of this tissue in the ratios of 72, 52, and 36 per cent respectively. These figures indicate a definite relation between the depth of the lesion and the probable presence of 'pathological' secondary dentin.

56. DEPTH OF SILVER NITRATE PENETRATION. *H. A. Zander, D.D.S., M.S. and D. Y. Burrill, A.B., D.D.S., School of Dentistry, Northwestern University, Chicago, Ill.* Howe's ammoniacal solution of silver nitrate has been applied to cavities in sound human teeth and to cavities cut in dogs' teeth. The effects of variations in duration of application, type of precipitant, order of application of solution and precipitant and time elapsing between the precipitation and extraction of the tooth have been studied. It has been found that variations in the duration of application of the solution do not appreciably affect depth of penetration. Variations in the type of precipitant produce no change, nor does a reversal of the order of application with the precipitant applied before the silver nitrate solution. It was found, however, that when the tooth was extracted immediately after the precipitation of the silver nitrate solution the penetration was to only a limited depth in the dentin, while if the tooth was left in place for a month after the precipitation the particles of precipitate from the silver nitrate solution had penetrated through the sound dentin and into the pulp. It is suggested that the particles may have been carried through the dentin by the dental lymph. Particles reaching the pulp produced some change in the pulp but did not produce sufficient irritation to cause concern.

57. MASTICATORY STRESSES AND THEIR RELATION TO DENTAL CARIES. *Meyer Klatsky, D.D.S., Health Center of the Workmen's Circle, New York City.* Masticatory stresses of 100 males and 100 females were measured by means of the gnathodynamometer. In the male group, the highest masticatory pressure recorded was 210 pounds, and the lowest 55 pounds. Average for the 100 males was 112.86 pounds on the left side, and 119.58 on the right. For females, the highest was 165 pounds and the lowest 25 pounds. Average 83.91 pounds on the left and 85.75 on the right side. Each individual studied was also examined for caries. The caries index ranged from 0 to 50 in the male group, average 18.96; for females, 0 to 51, average 23.82. A comparison of the male and female records shows that the biting stress of the average male is much greater than that of the average female; the caries index of the average male was much lower than that of the female group. A similar inverse ratio between the amount of biting stress and the dental caries index seems to exist also when comparisons are made within the sex groups. This leads to the conclusion that

the state of development of the masticatory apparatus is a determining factor in the incidence of dental caries.

58. EFFECTS OF TOPICALLY APPLIED FLUORINE ON HUMAN DENTAL CARIES, INCLUDING A METHOD FOR ITS APPLICATION. *Virgil D. Cheyne, D.D.S., Ph.D. and Thurman B. Rice, M.D., Indiana University School of Dentistry, Indianapolis, Ind.* Ability of fully formed and erupted teeth to absorb sufficient fluorine by local applictions to make them more resistant to dental caries was studied. Because of simplicity of technic the suggestion is made that this procedure may be used for clinical control of caries. Effectiveness of locally applied fluorine was tested on deciduous canine and molar teeth of an experimental group of 46 boys and girls divided into control (19) and fluorine-treated (27). The children were born in the city (with water low in fluorine content) and had lived there continuously since birth. Average age of children at beginning of experiment was 5.52 years; at time of last treatment, 6.09 years. Average interval between treatments was approximately 0.28 years. All except 1 child evidenced active caries at the beginning of study. Fluorine, applied as potassium fluoride in aqueous solution (1 cc. applied from 4 to 6 minutes per treatment) had concentrations from 60,000 p.p.m. to 500 p.p.m. Number of surfaces with active lesions in control group averaged 9.95 per child at initial clinical examination; 15.44 at last; inactive lesions increased from 3.00 to 3.55; 6.04 surfaces developing new lesions during period. Decrease from 12.85 to 11.98 total surfaces with active lesions was noted in fluorine-treated group (lesions showing clinical signs of dental decay at initial examination but with evidence of caries arrest at last examination, had been removed from active group). 3.09 surfaces per child developed irregularities or breaks in enamel, but remained inactive in fluorine-children's teeth. Data indicates that application of fluorine in manner described is efficient in suppressing carious activity in existing lesions as well as in preventing development of new lesions in deciduous canines and molars. *L. acidophilus* counts taken from saliva samples were low in number examined, but showed no tendency toward correlation.

IX. FIFTH SESSION: AFTERNOON, MARCH 14; ABSTRACTS 59–72

59. SUSCEPTIBILITY TO DENTAL CARIES AND FAMILY INCOME. *Henry Klein, D.D.S., Sc.D., National Institute of Health, Bethesda, Md.* It is generally recognized that economic status and health are closely related. A large array of data shows that persons of low-income levels have more illness than individuals in comfortable economic circumstances. Recent findings of the National Health Survey have shown that persons on relief have 8 times as much non-respiratory tuberculosis, 5 times more blindness and deafness, 3 times as many orthopedic impairments, close to 3 times as much nervous and mental diseases and twice as many disabilities due to accidents, as persons in families of incomes of $3,000 or more per year. The findings reported herein provide one of the striking exceptions to this general rule. The material of the present report reveals that among well-to-do, and relatively poor children, there are about equal numbers who have few carious teeth and about as many rich children as poor children who have large numbers of teeth which have been attacked by caries. Children

of families of high income receive diets of better quality and quantity and they are more advanced in skeletal age. The data indicate also that the well-to-do children receive more dental care in the form of fillings and they have fewer teeth extracted. In substance, the environment of the well-to-do children may be assumed to be more favorable for health than that which obtains for the poorer children; yet these clear-cut differences in environmental factors such as diet, housing, dental fillings and other extrinsic variables, seem to produce little difference in the caries susceptibility of the 2 groups.

60. UTILIZATION OF LACTIC AND PYRUVIC ACIDS BY ORAL MICROORGANISMS. *Isaac Neuwirth, Ph.D., and William H. Summerson, Ph.D. College of Dentistry, New York University and Cornell University Medical College, New York.* In work previously reported, (Summerson, W. H., and Neuwirth, I., *J. D. Res.*, **20**: 157, 1941) it was shown by chemical and manometric methods of analysis that oral microorganisms acting on glucose in saliva as a medium produce significantly more acid than can be accounted for by the amounts of lactic acid and pyruvic acid found. A partial explanation for this is indicated by the work now reported, which shows that oral microorganisms can metabolise both lactic and pyruvic acids almost as rapidly as they are formed. The metabolism of lactic acid leads to an intermediate production of significant amounts of pyruvic acid, but the further metabolism of pyruvic acid produces no lactic acid. Thus the appearance of lactic and pyruvic acids in the metabolism of glucose by oral microorganisms represents an intermediate and not a final stage in acid production. The nature of the acid or acids ultimately obtained is under investigation. These experiments were carried out with saliva obtained from carious and non-carious subjects. As in our previous work, no significant differences were evident between these 2 groups with regard to either acid production from glucose or the utilization of lactic and pyruvic acids.

61. CHEMICAL CHANGES IN DEVELOPING ENAMEL. *Martin Deakin, D.D.S., Ph.D., School of Dental Medicine, Harvard University, Boston, Mass.* Forty-five samples of enamel at varying stages of calcification, obtained from unerupted second molars of pigs, were analyzed for water, organic, and inorganic contents and degree of hardness of each was roughly determined with a probe. Density of each sample was obtained by flotation in mixtures of bromoform and petroleum ether. From density and wet weight, volumes were calculated and all values for the constituents expressed in mgm/mm^3. These values were plotted against density with following results: 1. Density varied from 1.45 in softest samples to 2.70 in hardest; fully formed enamel from an erupted tooth—2.76. 2. Inorganic content (measured as ash minus CO_2) increased in a straight line from 0.50 mg./cu.mm. (37 per cent of wet weight) to 2.53 mg./cu.mm. (91.7 per cent of wet weight). 3. Water content averaged 0.64 mg./cu.mm. (44 per cent of wet weight) in softest samples, remained constant between densities of 1.45 and 1.70, and then decreased in a straight line to 0.12 mg./cu.mm. (4.3 per cent of wet weights) in enamel of erupted teeth. 4. Organic material decreased rapidly from 0.27 mg./cu.mm. (19 per cent of wet weight) in softest enamel to 0.05 mg./cu.mm. (1.8 per cent of wet weight) at a density of 1.65, remaining constant for all higher densities. 5. From density 1.45 to 1.75 all

enamel samples were very soft and cut without fracturing; from 1.75 to 2.25 hardness increased gradually with density, material being soft enough to cut readily, but friable; above density 2.25 all samples were very hard and could not be cut with scalpel. Since hardening of enamel is attended by deposition of inorganic salts at constant rate, it is evident that process is more than a "crystallization" or "maturation" of calcium salts *already* present in the organic matrix. Instead, hardening process may be function of relative concentrations of all 3 components, water, inorganic, and organic material. (To be published in *J. D. Res.*)

62. SOLUTION OF DENTIN POWDER BY INORGANIC ACIDS. *Louis I. Grossman, Dr. Med. Dent., School of Dentistry, University of Pennsylvania, Philadelphia, Pa.* Since 1894, when Callahan advocated sulphuric acid for the enlargement of root canals, various acids have been used for that purpose. The relative effectiveness of these has not been investigated. The object of this study was to determine which acid is most effective for dissolving dentin. *Method:* 100–200 mesh dentin powder was prepared from extracted human teeth. 30 mg. of this powder was placed in each test tube and 2 cc. of each of the following acids was then added: (Group 1) HCl, HNO_3, H_2SO_4, in 5/M, 2.5/M and 1/M concentrations; (Group 2) 50 per cent aqua regia, 50 per cent aqua regia in reverse proportions, and 50 per cent HCl plus 50 per cent HNO_3; (Group 3) $HClO_4$ and phenolsulphonic acid. The test tubes were placed in a rack and shaken on a Boerner shaking machine for 10 minutes, centrifuged at 1500 r.p.m. for 2 minutes, and examined. This was repeated until complete solution occurred (end point) or for a maximum of 130 minutes. *Results:* 50 per cent aqua regia in reverse proportions was more effective than any other acid examined. (2) HNO_3 was slightly more effective than HCl. (3) Higher molar concentrations of acids were more effective than lower concentrations. (4) Sulphuric acid and phenol-sulphonic acid invariably produced insoluble precipitates.

63. A STRUCTURELESS, ORGANIC DEPOSIT ON TEETH. *R. S. Manly, Ph.D., Ivorydale, O.* A thin, structureless, organic pellicle has been found to form regularly on the teeth of a small percentage of the persons who do not use dentifrice abrasives in their oral hygiene. When the deposit was scraped from the teeth and tested it gave a positive xanthoproteic reaction, was insoluble at room temperature, and soluble only in strong hydrolytic solutions at 90°C., suggesting that it is a keratin. Microscopically, the film consisted of a structureless, bacteria-free, faintly basophilic pellicle with which were frequently associated traces of a granular, acidophilic substance. Because the film contained no bacteria, did not stain with disclosing solutions, and could not be removed from the teeth by liquid dentifrice, it differed from materia alba. In its preferential location on labial surfaces of the teeth and its low inorganic percentage, the deposit was unlike calculus. On the other hand the properties of this film seem to fit the classical description of the colorless pellicle of Nasmyth's membrane. Some possible origins of this deposit are discussed.

64. RADIOPHOSPHORUS METABOLISM OF PULPLESS TEETH. *Joseph F. Volker, D.D.S., J. Edward Gilda, D.D.S. and James T. Ginn, D.D.S., School of Medicine*

and Dentistry, University of Rochester, Rochester, N. Y. Six adult dogs who had previously had the pulp removed from incisor and canine teeth of 1 side of the maxillae, were given subcutaneous injection of radiophosphorus (P^{32}). After 24 hours the animals were sacrificed and the radiophosphorus content of the pulpless teeth and comparable vital teeth in the same mouth was determined. The pulpless tooth was found to have a definite radiophosphorus metabolism, probably via the periodontal membrane. Pulp extirpation resulted in a decrease in the amount of the isotope deposited in the tooth. The decrease is more marked in the young than in the old tooth and is probably related to the physiological recession of the pulp with age. The radiophosphorus metabolism of the crown is more affected than is the root by pulp removal. Detectable amounts of P^{32} can be found in the enamel of teeth with root canal fillings.

65. IN VITRO STUDIES ON UPTAKE OF RADIOPHOSPHORUS (P^{32}) BY CALCIFIED TISSUES OF WHOLE TEETH AS INDICATED BY RADIOAUTOGRAPHS. *H. B. McCauley, D.D.S., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* Various surfaces of intact human teeth were covered with collodion, and the teeth immersed in an aqueous solution containing P^{32}. After 44 hours in the solution, they were removed, and prepared in longitudinal sections which were backed with lead foil and placed on an unexposed no-screen x-ray film, where they remained undisturbed for 60 hours. The sections were then removed and the negative developed. The resulting radioautographs indicated that radiophosphorus entered the dentin via the pulp and the cementum. Root dentin seemed to pick up more of the element than crown dentin. The smallest deposits were found in enamel. Tooth surface defects offered a convenient pathway for the penetration of P^{32} into the tooth. It was possible to correlate the radioautographic findings with the radiophosphorus distribution as measured with the Geiger-Müller counter.

66. ADSORPTION OF SODIUM BY ENAMEL, DENTIN, BONE AND HYDROXYLAPATITE AS SHOWN BY THE RADIOACTIVE ISOTOPE. *Harold C. Hodge, Ph.D., William F. Koss, D.D.S., James T. Ginn, D.D.S., John F. Bonner, M.S. and Gerhard Dessauer, Ph.D., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* Fifty mgm. samples of powdered enamel, dentin, bone and hydroxylapatite were exposed to solutions of various concentrations of sodium chloride at 40°C. for 30 minutes. Radiosodium was used as a tracer. Each of the calcified tissues and the synthetic apatite adsorbed sodium from the solutions in accordance with the Freundlich adsorption isotherm. The relation of this phenomenon to the sodium metabolism in the body is discussed.

67. COMPARISON OF COMPOSITION OF ACID ASHED AND ALKALINE ASHED ENAMEL AND DENTIN. *Mary Jane Bird, B.A., Harriet Gallup, Jacob Gaudino, Harold C. Hodge, Ph.D., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* Fifty teeth of caries class 1 or 2 were separated into enamel and dentin. One aliquot of each sample was ashed in alkaline glycol. A second aliquot was ashed by microincineration with nitric acid. Differences in phosphorus, calcium, and magnesium content of acid ashed and alkaline ashed samples were studied. The percentages of dentin phosphorus and calcium were greater in the acid ashed than the alkaline ashed material. Differences in enamel phosphorus and

calcium were negligible. Differences in magnesium content of the ashed samples were not statistically significant.

68. X-RAY DIFFRACTION STUDIES OF CALCIUM PHOSPHATES. *John F. Bonner, M.S., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* The physical properties of the calcium salts of orthophosphoric acid and their derivatives have been studied. Melting points, crystalline form and refractive index have been correlated with x-ray diffraction patterns of 11 different compounds. The reaction—tricalcium phosphate + calcium oxide + water → hydroxylapatite—was found to take place at high temperatures. The existence of a calcium tetraphosphate could not be confirmed. Additional evidence for the structures assigned to fluorapatite and hydroxylapatite by Bale has been obtained.

69. SALIVARY SECRETIONS FROM DIFFERENT DUCTS OF THE CAT. *Norman S. Simmons, B.S., D.M.D., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* All 6 ducts of cats were resected and the secretions collected separately after pilocarpine stimulation. Secretion of the oral mucosa was collected from a pool in the oral cavity. Adult cats were used and secretions collected for ½ hour. Average secretion rate was as follows: submaxillary —11.7 cc., parotid—2.8 cc., sublingual—0.20 cc., oral mucosa—4.5 cc. The oral mucosa secreted approximately the same volume as both parotids. Submaxillary gland secretion was approximately 4 times that of parotid and 60 times that of sublingual. Viscosity of the secretions were: parotid—1.16, submaxillary 3.04, relative to water as 1. Secretions of sublingual gland and mucosa are not homogeneous and viscosity cannot be measured as secreted. However, on removal of large clumps of mucin, remainder gives relative viscosity of from 50–100. On incubation submaxillary and parotid secretions show no change in viscosity. Mucosal secretion shows loss of viscosity at very rapid rate (from 50 down to 5 in 45 minutes and remains at 2 after 3 hours). Parotid saliva causes no change in viscosity of submaxillary saliva. Mixed saliva shows change in precipitation as found in human saliva on incubation. This also parallels viscosity loss. Mucin of mucosal secretion gives same precipitation characteristics as does that of sublingual. Submaxillary mucin is soluble in 1 per cent acetic acid.

70. SECRETION OF INTRAVENOUSLY INJECTED ELECTROLYTES IN SUBMAXILLARY SALIVA OF CATS. *J. H. Wills, Ph.D., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* Radioactive sodium, potassium, chlorine, fluorine and phosphorus appeared in submaxillary saliva within 1 minute after injection via femoral vein during salivary secretion, produced by either chorda stimulation or pilocarpine injection. Pilocarpine administration again after injection of radioactive material usually augmented secretion of electrolyte. Average rates of secretion (p.p.m. injected per min.) were:

	Chorda	*Pilocarpine*
Na	9	15
K	135	106
Cl	214	90
F	40	
P	18	27

For K and Cl, rates with pilocarpine were probably significantly different from those with chorda stimulation.

71. HISTOLOGICAL INVESTIGATION OF CANCER OF MANDIBLE WITH CLINICAL REMARKS. *E. Kotanyi, M.D., Texas Dental College, Houston, Texas.* Clinical diagnosis of oral cancer must always be histologically verified, especially when extended surgical treatment is planned. Smallest granulations of oral mucous membrane must be considered important enough to be examined histologically. In a few reported cases, seemingly common, inflammatory, granulation tissue around the apex has proved to be cancer. Relatively few cases are described where histological changes of the surrounding tissues in cancer of the jaw were examined in serial sections. An exarticulated lower jaw with cancer was cut in bucco-lingual, serial sections. The mandible was cut in 6 blocks, and these blocks were then further subdivided. The tissues, including the mucous membrane, showed different stages of involvement. At some places leukoplakia could be found with acanthosis of epithelium and infiltration around papillae. Degeneration of covering epithelium transforming into carcinoma was evident, in other parts of the jaw tumor grew, secondarily, toward oral cavity, which led to secondary exulceration. Histological pictures of different types of ulcer were shown. Bone marrow reacted in characteristic manner at approach of tumor, adjacent fatty marrow being transformed into fibrous marrow, in most cases either with an endosteal bone apposition or resorption. Apposition occurred when epithelial pearls were some distance from the bone; resorption, when they were nearer. At one place roof of mandibular canal was destroyed, and epithelial pearls advanced either between nerves or between mandibular canal and its content. At other places very active buccal and lingual subperiosteal bone formation took place. Degeneration and destruction of muscles occurred leaving only tendon fibers in some places. Although epithelioma affected great part of jaw and covered it buccally and lingually, lymph glands were only enlarged, and salivary glands showed inflammatory reaction.

72. OSTEOGENESIS IMPERFECTA AND ODONTOGENESIS IMPERFECTA (HEREDITARY OPALESCENT DENTIN). *Russell J. Blattner, M.D., Florence Heys, Ph.D. and Hamilton B. G. Robinson, D.D.S., M.S., Schools of Medicine and Dentistry, Washington University and St. Louis Children's Hospital, St. Louis, Mo.* Odontogenesis imperfecta has been observed in 11 individuals of 6 families in the St. Louis area and it is known to exist in many other members of these families. Osteogenesis imperfecta was observed in 4 individuals in 3 of these families and a case strongly suggesting brittle bones was reported in the 4th family. In none of those studied were blue sclera observed. A Mendelian dominant was evident for the odontogenesis imperfecta in 5 families and indicated in the other. Sporadic distribution of the osteogenesis imperfecta suggested a "familial" pattern. A number of authors have reported characteristically imperfect dentin from at least 12 individuals with osteogenesis imperfecta. Their cases, with those reported here, represent 17 families with evidence of concomitant existence of the 2 conditions. Since both are relatively rare there is slight probability that this association is the result of chance. It is suggested that they are: 1. different degrees of a fundamental hereditary dysplasia of mesoderm, 2. two

abnormalities brought about by a single hereditary factor or 3. two associated conditions—one a dominant (odontogenesis imperfecta) and the other possibly a recessive (osteogenesis imperfecta).

X. Sixth Session: Evening, March 14; Abstracts 73–77

73. The electronic microscope: a new tool for the research worker. *James Hillier, Ph.D., Camden, N.J.* The principle of the electronic microscope was described and illustrated by diagrams and photographs. Many photomicrographs, made with the aid of the electronic microscope, were used to illustrate the potential uses of this greater resolving power in science and industry.

74. Dental science and dental art grant-in-aid. *Samuel M. Gordon, Ph.D., Major, U.S.A.* The second annual Dental Science and Dental Art Grant-in-Aid was made, upon recommendation of the Committee, to A. H. Kneisner of Western Reserve University to conduct further studies on the nutritional requirements of lactobacilli.

75. Presidential address. *Isaac Schour, D.D.S., Ph.D., University of Illinois, Chicago, Ill.* (pages 285–289).

76. Introduction of president-elect. *Leuman M. Waugh, D.D.S., Columbia University, New York City* (pages 289–291).

77. Inaugural address. *Charles F. Bodecker, D.D.S., Columbia University, New York City* (pages 291–295).

XI. Papers Read by Title: Abstracts 78–120

78. Epithelium in the pulp. *M. S. Aisenberg, D.D.S., School of Dentistry, Maryland University, Baltimore, Md.* Epithelium migrates into the dental pulp from activated epithelial rests. The epithelium enters through the apical foramen, through accidental root perforations and in cases of internal resorption. One case of metastasis of a squamous epithelioma into the pulp is presented.

79. Fluorine derived from food. *W. D. Armstrong, Ph.D., M.D., and M. Knowlton, B.S., School of Dentistry, University of Minnesota, Minneapolis, Minn.* Fluorine analyses of the entire 3 meals served to the house staff of the Minnesota General Hospitals indicate a daily intake of fluorine from the food of 0.27 to 0.32 mg. per day. In so far as this dietary represents the average distribution and intake of food the results can be taken as an approximate measure of the average fluorine intake from sources other than water.

80. Use of radioactive calcium in the study of bones and teeth. *W. D. Armstrong, Ph.D., M.D. and C. P. Barnum, Ph.D., John Williams, Ph.D., and Vincent Kelly, M.S., School of Dentistry, University of Minnesota, Minneapolis, Minn.* The following results, in terms of percentage of the total dose of calcium 45, per gram of ash were found 5 days after feeding of the radioactive calcium by stomach tube: diaphysis 3.98, incisor dentin 2.28, and molar dentin 0.53. Corresponding figures for radiophosphorus in the same tissues were: diaphysis 5.73, incisor dentin 4.41, and molar dentin 1.13.

81. A filamentous microorganism isolated from stained teeth. *Henry A. Bartels, B.S., D.D.S., School of Dental and Oral Surgery, Columbia University,*

New York City. A filamentous organism was isolated from a dark brownish stain adherent to the labial surface of a man's incisal teeth. Growth of the organism as minute tenacious colonies was obtained on blood agar plates incubated anaerobically for 72 hours. Subsequent subcultures have been successfully cultivated aerobically in saliva infusion agar. The microorganism was not found to be pathogenic for either mice or guinea pigs. Whether the organism should be classified as a member of the leptothrix or actinomyces groups is still undetermined. Further studies on its morphological, cultural and biochemical characteristics are in progress.

82. CENTRAL GIANT CELL TUMORS OF THE JAWS. *Adolph Berger, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Central giant cell tumors of the jaws are comparatively rare. Pathologists are not altogether in accord about many aspects of the giant cell tumor of bone. Some believe that it is a form of inflammatory resorptive lesion which develops at the site of a hemorrhage, others that it represents hypertrophy and hyperplasia of osteoclasts left at the site of endochondral ossification. Some investigators found that giant cell tumors of bone often exhibit clinical aggressiveness and in some instances may even undergo malignant transformation. It has recently been shown that the subject of giant cell tumors of bone has been confused by undue emphasis upon the giant cell alone. The characteristic stromal cells as essential elements in determining the nature of the growths have been overlooked. As a result some writers have included under giant cell tumors as variants such tumors as chondromas, xanthofibromas, epulides and brown tumors of hyperparathyroidism. In the stricter sense these are not giant cell tumors. The differential diagnosis between true and spurious giant cell tumors of the jaws is frequently difficult. Five cases of central giant cell tumors of mandible and maxilla demonstrate the diagnostic points.

83. HISTOLOGIC STUDIES ON JAWS OF MONKEYS CONTAINING VITALLIUM IMPLANTS. *J. L. Bernier, D.D.S., M.S. and C. P. Canby, D.D.S., Army Medical Museum and U. S. Army Dental School, Washington, D.C.* Because of the importance of Vitallium in maxillo-facial surgery an attempt was made to determine the reaction of the oral tissues to this metal. Implants, in the form of small screws, were inserted into the alveolus following the extraction of the canine teeth. Several animals were used, from 2 to 4 implants being placed in each animal. In addition, similar implants were inserted into the body of the mandible extra-orally. These were placed in position in the lower border of the mandible in the submental region. A portion of the screw was allowed to extend above the skin surface. Histologic examination of jaws containing these implants indicates a high degree of tolerance of the tissue to this metal. Osteoblastic activity was noted in close apposition to the implants, new bone filling the serations of the screws. Fibroblastic proliferation of the periodontal tissue was a prominent feature. There appeared to be a partially abortive attempt of this tissue to assume the functions of the normal periodontal membrane by lining the space between the bone and the metal.

84. TISSUE REACTIONS FOLLOWING EXPERIMENTAL TOOTH FRACTURE. *Gerrit*

Bevelander, College of Dentistry, New York University, New York City. A deciduous molar of a dog was subjected to fracture of the crown and root. The tooth with the partially removed crown was allowed to remain *in situ* for 3 weeks, when the jaw segment was removed and prepared for histological examination. The following tissue reactions were observed in this specimen: The non-calcified tissues of the tooth showed proliferation of gingival epithelium in an attempted "pulp-capping" reaction, localized non-purulent pulpitis, fibrous degeneration of the pulp and some odontoblasts, and irregular calcific deposits in the pulp. Calcified tissues of the tooth showed fractures in 5 different areas. Some fractures showed round cell infiltration, some complete fibrous union, and one developed a partial callus on the pulpal side. Some dentin was resorbed, in other areas irregular dentin was deposited. Spicules of dentin which had been splintered off the fragments seem to have undergone no change within the pulp cavity. The extra-dental tissues presented round-cell infiltration in the peridental membrane in a region in continuity with the pulp via one of the transverse fractures of the root. In addition, some of the tissues enveloping the developing permanent tooth germs were displaced. Despite these marked reactions the tooth was still firmly anchored in the alveolus and the root fractures showed a high degree of adaptation within this relatively short time. (To be published in *J. D. Res.*)

85. RELATIONSHIP BETWEEN ACID PRODUCTION BY SALIVA AND ITS BACTERIAL FLORA AND CARIES. *B. G. Bibby, D.M.D., Ph.D., and Dorothy W. Maurer, Tufts Dental College, Boston, Mass.* To determine whether the activity of dental caries was related to acid producing potentiality of saliva and whether this property was related to any particular component of bacterial flora, studies were made of acid formation and bacterial flora of paraffin stimulated salivas from 22 patients with active caries, 13 with moderate caries, and 19 with no caries. Acid formation was measured in two 5 cc. samples of saliva to which glucose had been added to give a 1 per cent solution. One sample was titrated with N/10 alkali after 6 hours incubation at 37°, and other to which 200 mg. of powdered dentin had been added was titrated after 24 hours. Total bacterial population was estimated by hemocytometer count and total viable count and streptococcal count by plating on oatmeal bread agar containing 2 per cent horse serum. Strong acid-forming streptococci were determined by count on this medium modified by addition of 1 per cent of glucose and about 0.1 per cent of brom cresol purple. Hadley Kulp's tomato juice agar was used for count of lactobacilli and yeasts. Saliva from patients with active caries produced more acid (average 2.05 cc. at 6 and 4.15 cc. of N/10 acid at 24 hours) than that from moderate caries group (averages 1.19 and 3.51, respectively), and from caries-free patients, (average 1.68 and 2.75, respectively). Hemocytometer counts, total of viable organisms, percentages of viable organisms and numbers of lactobacilli and yeasts paralleled acid formation in different groups, but count for acid-forming streptococci was highest in caries-free group. Variations in acid titrations and bacterial counts were wide, but statistically significant differences were found to exist between acid production at 6 and 24 hours, hemocytometer counts, total viable organisms and lactobacilli counts in different groups. Repeated

tests on same individuals showed relatively high degree of constancy. It is not possible to point to any particular factor as being responsible for different activities in acid production, but it seems likely that total bacterial count is more important than any other single factor.

86. PROPOSED METHOD FOR AN EFFECTIVE PULP TREATMENT. *I. Borden, J Campbell, J. Nuckells, D.D.S., College of Dentistry, University of California, San Francisco, Cal.* Prognosis of pulp capping, especially in adults, is unfavorable. To treat the contaminated pulp when exposed, the drug employed must be compatible with living tissue, yet, must inactivate bacteria to the extent that the body defenses can overcome the infection. Sodium sulfadiazine is proposed. Of the 19 sulfanamide compounds studied by tissue culture method, the characteristics of sodium sulfadiazine make it seem best suited for local application under the conditions proposed below. It appears most effective in action against a mixed bacterial flora. Hyperemia frequently accompanies pulp exposure. Since the pulp is surrounded by hard, unyielding tissues, pulp necrosis may be a result due to strangulation of the blood vessels. To alleviate this condition, it is suggested that the exposed pulp be induced to bleed and the sodium sulfadiazine sprinkled into the organizing clot. The clot then acts as a cushioning agent, and, being a nutrient substance for the reparative elements of the pulp, provides sufficient room for the hyperemic pulp as the clot is resorbed. To provide an ideal environment for the exposed pulp containing the clot and sodium sulfadiazine, and to keep it from further contamination and irritation, a sterile pellet of glycerolmonostearate is sealed over the organizing clot. Crown and bridge cement is flowed over the glycerolmonostearate and, following a 6-month checkup and satisfactory progress, a permanent restoration is placed.

87. COMPLETE ANODONTIA: A SERIAL ROENTGENOGRAPHIC CEPHALOMETRIC APPRAISAL. *Allan G. Brodie, D.D.S., Ph.D. and Bernard G. Sarnat, M.D., D.D.S., College of Dentistry, University of Illinois, Chicago, Ill.* Serial lateral roentgenograms were taken to assess the development of the face and jaws in a white male with complete anodontia. A further purpose was to compare this development with the normal as to size, proportion and rate of growth. The technique of assessing craniofacial development by serial cephalometric roentgenograms has been adequately described by Broadbent and Brodie. Roentgenograms were taken at 6-month intervals from 1 year 10 months to 5 years 4 months. These were analyzed and compared to those of 20 normal controls of a similar age group. The findings revealed a normal pattern of craniofacial growth. The length of cranium and cranial base were small but normal, and the vertical and horizontal measurements of the face were somewhat less than small normal except for the length of lower border of mandible which was normal. The angular relationships were close to the mean values of the controls and these relations, as in the normal, had a strong tendency to remain stable. The alveolar processes were absent.

88. GRENZ RAY IN TREATMENT OF LEUKOPLAKIA. *Ralph Howard Brodsky, D.M.D., Sea View Hospital, New York.* In a series of 10 cases of leukoplakia, ranging from simple leucoplakia spots to extensive markedly elevated lesions,

the Grenz ray has been employed successfully in eradicating the lesions. In 2 instances there was evidence of a beginning breaking-down process, which, at the conclusion of the radiation therapy was no longer manifest.

89. RELATIONSHIP OF BLOOD PLASMA VITAMIN C LEVEL TO GINGIVAL AND PERIDONTAL DISEASE. *Dan Y. Burrill, D.D.S., Dental School, Northwestern University, Chicago, Ill.* Records of 1396 clinic patients, giving for each the blood plasma vitamin C level, and the susceptibility to gingival and periodontal disease, indicate that there is no significant relationship between the vitamin C level and such diseases. The range of vitamin C levels was the same for all classes of patients, from 0.08 to 2.16 mg. per 100 cc. plasma, while the mean, median or mode of any class did not vary more than 0.07 mg. from the mean, median or mode of any other class. Seasonal variations in incidence of gingivitis did not correspond with seasonal variations in the vitamin C levels. It was found that patients having good oral conditions tended to have a slightly higher vitamin C level than those with poor oral conditions, but the difference probably means that patients of one type tended to take care of both mouth and diet, while patients of the other type tended to take care of neither. (To be published in *J. D. Res.*)

90. RELATIONSHIP BETWEEN BLOOD PLASMA VITAMIN C LEVELS AND CLINICALLY ESTIMATED CARIES SUSCEPTIBILITY. *Dan Y. Burrill, D.D.S., Dental School, Northwestern University, Chicago, Ill.* Records of 1291 patients, give for each the clinical estimate of caries susceptibility and the blood plasma vitamin C level. The vitamin C blood plasma ranges were 0.04 to 1.84 mg. per 100 cc. plasma for the group without caries, 0.08 to 2.04 for the group with moderate caries and 0.08 to 2.16 for the group with severe caries. The mean vitamin C levels for the same groups were respectively 0.55, 0.54 and 0.51 mg. per cent. The medians were respectively 0.48, 0.48 and 0.44 mg. per cent. The difference of 0.04 mg. per cent is insignificant.

91. STUDIES IN BONE PATHOLOGY. *Lester R. Cahn, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* To paraphrase Taylor's remark (discussion of Case #25211 of Case Records of the Massachusetts General Hospital, New England, May 25, 1939) "All lesions of bone are quite like a box of candy. You can shake and rattle and push it around, but until it is opened you cannot tell what is inside. It may be candy, it may be nuts or marbles. With lesions in the bone you cannot say whether you are dealing with a bone tumor, an inflammatory process, or some process of systemic or metabolic nature. You may be dealing furthermore with destruction due to external pressure." A number of lesions of bone, the roentgenograms of which were inconclusive, were studied histologically. Included in these studies were inflammatory, reparative and neoplastic changes. Our studies bear out Taylor's remark that it is quite impossible to make a diagnosis in many of these bone lesions by clinical or roentgenological examinations alone. They must be opened and studied histologically.

92. FAT IN CYST SACS. *Lester R. Cahn, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* One product of epithelial de-

generation is cholesterol. This is manifested in cyst sacs by formation of fusiform slits which housed, in vivo, cholesterol crystals. All cyst sacs do not show these slits. It was thought that it would be interesting to investigate whether fat was present in cyst sacs regardless of whether they showed cholesterol slits or not. Sacs were cut in half. One half was prepared in the ordinary manner of embedding in paraffin and staining with hematoxylin and eosin. Frozen sections were made of the other half and these were stained with Sudan 3 and Sudan 4. Fat was found in all the specimens examined regardless of whether the H and E sections showed cholesterol slits or not. The distribution of the fat was interesting.

93. PITFALLS IN HISTOLOICAL DIAGNOSIS WITH SPECIAL REFERENCE TO PSEUDOEPITHELIOMATOUS HYPERPLASIA. *Lester R. Cahn, D.D.S., College of Dental and Oral Surgery, Columbia University, New York City.* A number of lesions have been examined in the course of years in which a diagnosis of malignancy had been made and in which the lesion cleared up either spontaneously or by the application of some treatment which would have had no effect upon a true blastoma. On the other hand a diagnosis has been made of innocuousness of some lesion which proved to be misleading and not born out by the subsequent course of events. Lesions of both the epithelium and connective tissue were encountered. The former structure presented pictures that were most misleading. A number of case histories are presented in this paper together with a discussion of each. From a study of these cases it is concluded that in certain instances the histological interpretation must be secondary to the anatomical position of the lesion, its biological character, and the experience of the clinician. A study of these cases also emphasizes the fact that the pathologist should be conversant with the natural history of the conditions that he must interpret histologically.

94. THE MAST CELL. *Lester R. Cahn, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Mast cells were first described in 1877 by Ehrlich. They possess rather large granules that stain metachromatically by basic aniline dyes. In the oral cavity these cells are found normally in the oral mucous membrane, in the marrow of the jaw bones and occasionally in the dental pulp. They are found most abundantly in connective tissue near the capillary walls and in the walls of the larger blood vessels. For years their function has been unknown. Through the work of Jorpes, Holmgren and Wilander, we have learned that the mast cell is the source of heparin, an important anti-coagulant of the blood. An investigation of the mast cell from the histological aspect has been carried out. A probable reason for the increase in number of these cells in inflamed and otherwise abnormal tissue has been suggested.

95. THE EPITHELIAL SHEATH: ITS HISTOGENESIS AND FUNCTION. *Moses Diamond, D.D.S. and Edmund Applebaum, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Hertwig regarded the epithelial sheath he observed in amphibians as the formative organ of the root. Most contemporary observers regard the epithelial sheaths of human teeth as forma-

tive organs of tooth roots, but designate the region of the loop or the region of continuity between the inner and outer epithelium of the enamel organ as the epithelial sheath of Hertwig. Diamond and Weinmann have maintained that this region of the enamel organ denotes the eventual cervical terminal end of the tooth crown and plays no part in root development. Our evidence supports the conclusion of Diamond and Weinmann. The epithelial sheath is the root's formative organ and does not begin proliferation until the enamel matrix of the crown is completely formed and its calcification considerably advanced. During this rest period, the crown dentin continues to form and calcify. The crown dentin is initially stimulated into formation by the inner enamel epithelium. Root dentin is initially stimulated by the epithelial sheath and cannot therefore begin its formation until the sheath proliferates. The relatively fixed point of the epithelial sheath can only be manifest after the crown is virtually completed, and the enamel organ is reduced. The epithelial sheath can play no part in the eruptive mechanism of the tooth, for eruption continues long after the completed formation of the root when the epithelial sheath is degenerated. (To be published in *J. D. Res.*)

96. TREND IN ATTACK RATE OF DENTAL CARIES OF 358 U. S. COUNTIES. *Bion R. East, D.D.S. and Kurt Pohlen, Ph.D., Delamar Institute of Public Health, Columbia University, New York City.* In a previous study, D. M. F. (decayed, missing and filled) rates were determined according to the accumulated mouth-age of the teeth at time of examination. When these values were plotted on regular graph paper they followed, quite closely, parabolic curves; when plotted according to the double logarithmic system very accurate straight lines resulted. This raised the question whether this was a demonstration of a major rule following a hidden biological law of tooth decay or whether it was a phenomenon confined to these particular data. Data from 358 United States counties has been similarly treated. Each county curve has its individual slope yet the 3 points (only rates for the mean ages of 7, 10 and 13 were available) fall within a straight line with striking regularity. The deviation from a straight line was generally so small that in case the curve had been determined by the method of least squares these deviations would not exceed the mean error of the original points. The mean deviation for the 358 curves was 8 per cent. This regularity of trend in attack rate of dental caries among 358 counties is further evidence that such attacks do not occur in a hap-hazard manner but follow some hidden biological rule or law. The exact nature of the law and its operation is as yet obscure, but merits further investigation. (To be published in *J. D. Res.*)

97. EVALUATION OF DENTAL CARIES IN VITAL AND PULPLESS TEETH. *Bernard L. Feldman, D.D.S. and William Lefkowitz, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* A roentgenographic examination of teeth of 112 individuals aged 30 to 74 was made for cervical proximal caries in vital and pulpless teeth. Cervical proximal caries was the lesion of choice because the element of error in diagnosis from roentgenograms is minimal. The results indicate that the incidence of cervical caries is significantly less in pulpless teeth.

98. OSTEOLOGY OF THE GUINEA PIG SKULL. *Jerome Fleeman, D.D.S., Dental School, Northwestern University, Chicago, Ill.* Photographs and descriptions of the skull of the guinea pig in the English language texts are not generally available. Skulls of 8 healthy, adult animals were selected and used as a basis from which descriptions and photographs were made. These cover the skull as a whole, the individual cranial bones and the dentition.

99. DENTAL CARIES EXPERIENCE RATES AND THEIR COMPARISON. *William M. Gafafer, D.Sc., Institute of Health, U. S. Public Health Service, Bethesda, Md.* Dental caries experience rates representing probabilities may be directly compared with the use of ordinary methods. The dental caries experience rate, number of decayed, missing and filled permanent teeth per 100 persons examined, on the other hand, involves multiple events. To compare rates of this kind requires knowledge of the frequency distributions yielding the rates. A procedure of comparison involving the chi-square test was presented. (To be published in *J. D. Res.*)

100. IMPORTANCE OF THE MECHANICAL FACTORS UPON THE PROGRESS OF EXPERIMENTAL DENTAL CARIES IN THE RAT. *James T. Ginn, B.S., D.D.S., School of Medicine and Dentistry, University of Rochester, Rochester, N.Y.* Two groups of rats were placed on a caries-producing diet for 100 days. The animals in Group I were sacrificed at the end of this time and served as controls. The right maxillary molars were extracted in all the animals in group II, which were then continued on the same diet for 60 additional days, at which time they were sacrificed and the mandibular molars of both groups carefully examined. There was a close correlation for caries incidence, areas affected and total score (Cox, et al) in the molar teeth of either side in group I and in the teeth on the right side in group II. The left molars, where the opposing teeth were present throughout the experimental period, showed a much higher incidence of caries. The average total score in group I was 3.33 for the right side and 2.91 for the left. In group II the average total score was 2.76 for the right molars and 7.64 for the left. These results seem to indicate that local environmental factors in the mouth are important in the progress of the carious lesion in the rat, and that the most important factor concerned might possibly be mechanical in nature.

101. OPSONIN IN THE SALIVA OF CARIES-IMMUNE AND CARIES-SUSCEPTIBLE INDIVIDUALS. *Carolyn W. Hammond, B.S., M.A. and Joseph P. Weinmann, M.D., Chicago College of Dental Surgery, Chicago, Ill.* A series of phagocytosis experiments was carried out using saliva from a group of caries-immune individuals and a group of persons with rampant caries. Washed human leucocytes, serum, saliva and a washed suspension of oral lactobacilli were used. The saliva from persons with rampant caries stimulated phagocytosis on the average of 4 per cent. Saliva from caries-immune individuals stimulated phagocytosis on the average of 41 per cent. When leucocytes, organisms, serum and saliva were mixed, it was noted that the saliva apparently exerted an inhibiting effect on the phagocytosis-stimulating ability of the serum. This effect was most marked when saliva from individuals with rampant caries was used. The variation in

the opsonin content of caries-immune and caries-susceptible salivas may partly explain the effect of immunization against oral lactobacilli. (To be published in *J. D. Res.*)

102. PULP CHANGES AND THEIR RELATIONSHIP TO CLINICAL SYMPTOMATOLOGY. *Edward H. Hatton, M.D. and J. L. Bradley, D.D.S., Dental School, Northwestern University, Chicago, Ill.* The pulps of 62 teeth extracted from 44 different persons were studied by histological methods. More or less complete histories were obtained for each tooth examined. In order to secure quick fixation and thorough embedding as much of the external hard tissues as seemed advisable was ground off on a stone cooled in a stream of water. The teeth were sectioned after slow decalcification and long embedding in celloidin. As has been previously reported, pulp calcifications, various grades of pulp atrophy and marked dilatations of thin walled vessels occur in a very high percentage of this group of teeth. Even the most noteworthy changes of this type is in no instance of this series associated with a clinical history of pain that can be referred to the tooth pulp. The few teeth with pain of probable pulp origin have pulps with very outstanding changes of an inflammatory nature clearly of bacterial origin. This seems to justify a suspicion that marked pain originating definitely from the tooth pulp is likely to be associated with inflammatory changes of the pulp tissues rather than with atrophy, calcifications and vascular changes.

103. EFFECT OF CHEWING PARAFFIN AND GUM AFTER MEALS ON SALIVARY ACIDOPHILUS COUNTS. *Edward H. Hatton, M.D., Dental School, Northwestern University, Chicago, Ill.* If the total salivary acidophilus counts as determined by Jay and Hadley have any quantitative significance with respect to the activity of dental caries, such counts may be used to test the routine effect of almost any procedure on the quantitative incidence of *L. acidophilus* in the saliva and presumably, therefore, also on the degree of activity of the carious process. A group of 19 students, after a number of control counts all made in strict accordance with the methods prescribed by Jay, each chewed a stick of soft paraffin for at least 10 and no more than 15 minutes after each meal (3 times daily). The average of 5 to 6 counts taken during this period is 34.5 per cent of the counts made during the control period. Later under similar conditions each student chewed 1 slab of gum (commercial gum of the usual composition) for not less than 10 minutes nor more than 15 after each meal (3 times a day). Average of salivary acidophilus counts taken during this period is 67.5 per cent of the counts taken during the control periods when neither paraffin nor gum was chewed after meals. It is evident that chewing either paraffin or gum for 10 or 15 minutes after meals is associated with lower salivary acidophilus counts, although, as may be anticipated, the effect of chewing paraffin is greater than that of chewing gum.

104. CASE OF THROMBOCYTOPENIC PURPURA. *E. Kotanyi, M.D., Texas Dental College, Houston, Texas.* A 13 year old girl, pale, but otherwise healthy looking, had frequent nose bleeding for 1 year, and when she awakened in the morning her pillow was covered with blood from the gingivae. The slightest irritation of the mucous membrane of the oral cavity or brushing of the teeth

caused bleeding, which was sometimes very difficult to stop. Blood count (in the most advanced stage): erythrocytes, 3,500,000; leukocytes, 24,000; neutrophiles, 32 per cent; lymphocytes, 63 per cent; thrombocytes, 10,000. Blood transfusion gave only temporary improvement. After the blood transfusion the thrombocytes were as high as 95,000. The elimination of the spleen led to a nearly normal number of the erythrocytes (3,900,000), leukocytes (7,700) and slightly increased lymphocytes (39 per cent). The bleeding of the gingivae stopped. Only the labial gingivae of the lower anterior teeth showed slight gingivitis. The gingivae on the lingual part of the lower teeth showed neither calculus formation nor inflammation.

105. EFFECT OF A DEFICIENT DIET ON COMPOSITION OF TEETH AND BONES OF MATURE ANIMALS. *Axel P. Lund, Ph.D., D.D.S. and W. D. Armstrong, Ph.D., M.D., School of Dentistry, University of Minnesota, Minneapolis, Minn.* Adult albino rats received a diet free of vitamin D and containing 0.007 per cent calcium for 220 days. The animals were in a negative calcium balance during the entire period. The calcium and phosphorus contents, in terms of percentage by weight, of the enamel and dentin of the incisor and molar teeth did not differ from the results obtained with control animals. A decrease in density of the humeri of the experimental animals without a decrease in volume was observed. The quantity of calcium and phosphorus per unit volume of bone was 17 per cent less in the experimental group than in that of the controls.

106. FACTORS IN DENTIN ABRASION BY DENTIFRICES. *Richard S. Manly, Ph.D. and H. G. Miller, Ph.D., Ivorydale, O.* Studies have been made of various factors which might affect conclusions drawn concerning abrasion of cementum and dentin by brushing with modern dentifrices, using a new machine designed for brushing 8 teeth simultaneously and measuring cervical wear photographically by means of change in magnified silhouette. In absence of dentifrice abrasives wear was not appreciable. In teeth brushed with dry brushes deepest notches in cervical cementum and dentin averaged only 10 microns after 100,000 strokes. Brushing with water produced an average wear of only 5 microns, and liquid dentifrice gave no measurable abrasion with any of 7 different brands of hard tooth brushes. These figures may be compared with average, 920 microns per 100,000 strokes, for 10 abrasive-containing brands of dentifrices. Hardness of brush did not seem to influence amount of wear with abrasives. Using 33 per cent slurry of dentifrice was found to give less wear than application of solid abrasive to brush every 15 strokes in order to more nearly duplicate brushing in mouth. Practice of diluting abrasive with 2 parts water was upheld by finding that in mouth toothpaste on brush becomes diluted with from 1 to 4 parts of saliva. Artificial decalcification of cervical cementum and dentin made tissues susceptible to abrasion by brushing with liquid dentifrice or water, but wear was not as great as that produced on same teeth by abrasive-containing dentifrices.

107. ETIOLOGY AND TREATMENT OF RECURRENT ORAL APHTHAE. *Solomon N. Rosenstein, B.S., D.D.S., and Daniel E. Ziskin, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Several cases presenting

recurrent oral aphthae were studied to determine etiology and indicated treatment. In 1 group of 4 female patients, 30 to 51 years old, aphthae occurred in groups, at various locations on the mucous membranes, rarely on the gingivae. Individual lesions lasted up to 2 weeks; duration of the general complaint varied from several months up to 6 years. Allergy was eliminated as a causative factor by examination for hypersensitivity in the allergy clinic. Vitamin B deficiency was ruled out by history of diet and administration of large quantities of vitamin B complex without change in recurrence. Possibility of virus etiology was eliminated by negative results in animals tested with corneal inoculations from saliva. Careful search disclosed presence of trauma from incorrect toothbrushing and loose, ill-functioning partial dentures at the sites of the lesions. When these were corrected or removed the lesions healed and did not recur. On return of the suspected trauma the lesions reappeared, subsiding again on removal of the traumatic factor. In another group of 3 patients (1 female, 2 males) where 1 or 2 lesions occurred, attempts to treat only with vitamin B were unsuccessful. Elimination of trauma prevented their recurrence.

108. TOOTH DEVELOPMENT IN HIBERNATION. *Bernard G. Sarnat, M.D., D.D.S., and Walter E. Hook, M.D., College of Dentistry, University of Illinois, and Department of Medicine, University of Chicago, Chicago, Ill.* Developing teeth reflect metabolic changes promptly and accurately. In hibernation there is marked depression of general metabolism. This investigation was undertaken to determine effect on tooth development. Two methods were employed, intravital staining with alizarine red S to assess rate of dentin growth in ground sections and notching of incisors to determine rates of eruption and attrition. Nine control and 28 experimental 13-lined ground-squirrels were used. Hibernation was induced by withholding food and water for 2 days and then placing each animal in an individual cage in a dark constant-temperature room kept at 2–5°C. Findings are summarized below:

GROUP	HIBERNATION 2–5°C	RATE OF ATTRITION		RATE OF DENTIN APPOSITION
		Upper	Lower	
	per cent of time	*mm. per week*		*u per day*
I	81–100	0.1	0.1	1.5
II	24–71	0.2	1.0	2.5
III	0–20	0.4	2.2	6.6
Control	Room temp. (21°C.)	0.8	1.1	12.8

This report demonstrates that tooth development in 13-lined ground-squirrel kept at 2–5°C. was severely retarded in approximate proportion to time animal hibernated. This was in accord with marked depression of general metabolism in hibernation.

109. TOOTH DEVELOPMENT AND DENTAL CARIES IN CHILDREN WITH PROLONGED SEVERE DISTURBANCES AFFECTING GROWING BONES. *Eli H. Siegel, Sc.B., D.D.S., Lewis R. Stowe, D.D.S, and Daniel E. Ziskin, D.D.S., School of Dental and Oral*

Surgery, Columbia University, New York City. Clinical and x-ray examination of the jaws and teeth of children suffering from such diverse chronic conditions as renal rickets, refractory rickets, Cooley's anemia, hyperparathyroidism and generalized xanthomatosis were made. The development of teeth, as far as could be determined by clinical and roentgenographic examination, during these conditions, does not appear to be impaired. Study of microscopic disturbances in the teeth is being made. Caries experience in the deciduous and permanent teeth does not vary materially from the average experience of normal children. The clinical findings, in general, support experimental data reported by others, showing that the teeth develop independently of bone, and furthermore, in severe deprivation states utilize materials which would otherwise probably be used in bone formation. The presence of severe disturbances in calcium and phosphorus metabolism is not associated with an increased caries index.

110. BROWN OPALESCENT DENTIN ASSOCIATED WITH RETINITIS PIGMENTOSA. *Wm. G. Skillen, D.D.S. and Smith Freeman, M.D., Ph.D., Dental School, Northwestern University, Chicago, Ill.* Of 7 brothers and 4 sisters still living, 5 of the former, including this patient, had defective vision from a very early age. The teeth of the boys soon after their eruption were noticeably abnormal. Time of eruption was normal. Teeth gradually wore away. Father and mother, according to accounts, perfectly normal. The youngest of a sister's 4 children, a boy, is similarly affected. The children of 2 brothers and the children of 2 sisters apparently normal although 2 of them have slight defect in sight. Their teeth do not seem to be affected. On the mother's side, 3 of the brother's 8 children, 2 girls and 1 boy, are affected. The children of 2 other brothers and 3 other sisters are normal. On the father's side, existing relatives are normal. Radiographs of the teeth show the usual obliteration of pulp and short roots. Histologically, the dentin is not quite as irregular as sometimes has been described. A more complete medical study is being made, but to date there has been no syphilis or endocrine relationship detected.

111. THE WIDTH OF THE PERIDENTAL MEMBRANE IN A GROUP OF YOUNG INDIVIDUALS. *William G. Skillen, D.D.S. and Frederick Kogan, L.D.S., R.C.S., M.S.D., Dental School, Northwestern University, Chicago, Ill.* Measurements were made of a group between 8 and 13½ years of age. These measurements appear to contradict statements previously made that the peridental membrane in older individuals is one-half again as wide as in younger ones. As a matter of fact, in many instances the measurements obtained exceeded to a considerable extent those appearing in the literature from 20 years upward. Neither age nor function seemed to have any consistent relationship to the width of the membrane. In only one respect do these findings seem to agree with previous reports—that in general, the membrane on the distal surfaces of teeth is somewhat wider than on the mesial surfaces.

112. USE OF ACRYLIC SPLINTS IN CONSERVATIVE AND RADICAL PROCEDURES OF PERIODONTAL PRACTICE. *Sidney Sorrin, D.D.S., School of Dentistry, New York University, New York City.* With the introduction of the acrylic resins (methyl methacrylate) into dentistry, a new material for splinting is being utilized in

both conservative and radical procedures of periodontal therapy. For many years the author has resorted to fixed and removable splints for stabilzation of mobile teeth in periodontal treatment. During the past 6 months, an acrylic splint has been used for this purpose, and it presents many advantages over other types which have been employed. This preliminary report is intended to acquaint the profession with this method of stabilization and to encourage its further use and improvement. The colorless, transparent, clear acrylic has been our choice of material. Acrylic has an almost perfect adaptability and adhesiveness for enamel and remains in position without cementation. Stainless steel wire is employed for reinforcement purposes in areas where aesthetics are not required. The paper discusses the advantages of the acrylic splint over other appliances used for the purpose and presents photographs of cases.

113. DENTIN METAMORPHOSIS: ITS RELATIONSHIP TO PAIN. *Bernerd O. A. Thomas, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Vital teeth showing 1. slight gingival recession without cervical caries or abrasion, 2. well defined areas of cervical abrasion, caries, or both, or, 3. marked gingival recession with or without cervical caries or abrasion, were studied. A small cavity was cut into the dentin at the cervical area, approximately paralleling the direction of the dentinal tubules. Drilling was stopped when (and if) the patient first felt pain. The teeth were extracted and ground sections of each were prepared, parallel to the cavity. The results indicate: 1. In completely metamorphosed dentin it is possible to cut almost to the dental pulp without causing definite pain. 2. Pain is felt when the bur passes out of a well defined tract of metamorphosed dentin into dentin where the tubules are not occluded. 3. Pain is felt as soon as the bur enters the surface of dentin which has not undergone any metamorphosis. 4. Incomplete metamorphosis causes a definite decrease in the acuity of pain as compared to dentin whose tubules are all unoccluded. These results suggest a definite clinical application, especially as regards cavity preparation in the group 2 cases.

114. FAILURE TO PRODUCE DENTAL CARIES BY DISTURBANCE OF ACID-BASE BALANCE. *Bernerd O. A. Thomas, D.D.S. and Charles F. Bodecker, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City.* Experiments were performed on 3 litters of albino rats (9, 9, and 6 rats in each litter respectively), by means of daily subcutaneous injections of solutions as follows: 6 rats received 2 cc. $NaHCO_3$ (3 per cent) daily, 2 of them for 77 days, 4 for 112 days. Ten rats received alternate daily injections of 2 cc. $NaHCO_3$ (3 per cent) and 2 cc. NH_4Cl (1.5 per cent), each animal receiving from 38 to 54 injections of $NaHCO_3$, and 41 to 60 injections of NH_4Cl. Eight rats ($\frac{1}{3}$ of each litter) served as controls, and were not injected. The animals were kept on a diet containing necessary ingredients for normal growth and development as fine particles to prevent caries as a result of fracture lesions of enamel. By cardiapuncture, blood was obtained to ascertain whether injected solutions were effecting any noticeable alteration in the CO_2 content of the blood in experimental animals. Although the results indicate the $NaHCO_3$ raised the CO_2 content of the blood, and the NH_4Cl lowered it, these findings are based on

so few determinations that we feel that no conclusions can be drawn from them. The CO_2 content was higher in every case when the animal was etherized. The results do not agree with Forshufvud, who claimed that such daily disturbance of the acid-base equilibrium caused rampant caries in rats. The authors saw caries in only 1 case, a control animal. (To be published in *J. D. Res.*)

115. CONSTANCY OF THE POSITION AND FORM OF THE MANDIBLE. *John R. Thompson, D.D.S., M.S. and Allan G. Brodie, D.D.S., Ph.D., School of Dentistry, University of Illinois, Chicago, Ill.* Cephalometric study of growth of the head conclusively demonstrated that morphogenetic pattern and spacial position of mandible is established by at least 3 months of age. At birth jaws are wide apart and tongue occupies entire mouth cavity extending across alveolar processes to support closed lips. Angular relation of mandible as indicated by a tangent to lower border, to anterior cranial base, is found to be identical in infant without teeth and in same individual after all teeth are erupted. This evidence suggested cephalometric investigation of position of mandible in prosthetic patients. With cooperation of department of prosthetics, serial cephalometric x-rays were made before extraction, before and after insertion of dentures, and at approximately 6 months intervals thereafter on 90 patients requiring partial or complete restorations. Results of study to date are: 1. Physiological rest position of mandible is identical before and after loss of teeth. 2. When teeth are present physiological rest position always exhibits freeway space between upper and lower teeth. 3. When bite is opened by means of artificial dentures beyond limits of physiological rest gradual closure occurs by resorption of underlying bone. 4. Face does not shorten with loss of teeth. Typical edentulous appearance is result of lingual collapse of lips because of loss of their dental and bony support. In many cases labial loss of alveolar bone was equal to that of crest. 5. Position of mandible is determined by musculature and not by teeth. 6. No changes in form of mandible, aside from those occurring within alveolar process, could be demonstrated over the period of 3 years.

116. RADIOPHOSPHORUS (P^{32}) METABOLISM OF DECIDUOUS AND ERUPTED AND UNERUPTED PERMANENT TEETH. *Joseph F. Volker, D.D.S., Ph.D. and James T. Ginn, D.D.S., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* The radiophosphorus (P^{32}) metabolism of deciduous and erupted and unerupted permanent teeth has been studied in 6 young dogs, 5 of which were litter mates, and 4 young monkeys. Evidence has been obtained that the P^{32} metabolism of calcified portion of unerupted enamel and dentin is of a much greater magnitude than that of the same tissues of the erupted tooth. The amounts of the isotope found in the enamel and dentin of the unerupted tooth are similar and are comparable to those found in the adjoining bone. The radiophosphorus metabolism of the dentin of deciduous teeth undergoing resorption is decreased.

117. EFFECT OF SPECIES AND AGE OF THE RADIOPHOSPHORUS (P^{32}) METABOLISM OF THE DENTAL TISSUES. *Joseph F. Volker, D.D.S., Ph.D., School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.* Considerable experi-

mental data have been accumulated on the in vivo radiophosphorus metabolism of the teeth of rats, cats, dogs and monkeys. A limited amount of information on the same subject has also been obtained for the mouse and human. It would seem that each species has a characteristic radiophosphorus metabolism. The magnitude of this metabolism is greatest in the mouse and decreases progressively in the rat, cat, dog, monkey and human, in the order named. Evidence is available that indicates that within a given species the radiophosphorus metabolism of the dental tissues decreases with age.

118. STRENGTHS OF DENTAL PLASTERS AS VULCANIZING INVESTMENTS. *Howard K. Worner, M.Sc. (Melb.), A.A.C.I. National Health and Medical Research Council of Australia.* Comprehensive investigation of behaviour of different plasters and artificial stones used as investments for the vulcanization of dental rubber revealed that: 1. On heating in an autoclave under conditions pertaining in vulcanization of dental rubber, both ordinary plaster investments and hydrocal "stones" lose bulk of their strength between 115°C and 120°C. This corresponds closely with observed temperature of most marked dehydration of calcium sulphate dihydrate when heated in saturated steam. A small further decrease in strength generally occurs as investment is heated to vulcanizing temperature (160–170°C). On holding at this temperature material gradually weakens until after 2 to 3 hours most plasters and artificial stones soften to considerably less than half strength possessed on first reaching vulcanizing temperature. 2. From point of view of denture fit of most satisfactory cast and investment materials are those which retain high strength and suffer little expansion during vulcanizing treatment. In this respect artificial stones made from "hydrocal" are better than ordinary plaster of Paris investments, and these in turn are generally better than "anhydrite" or slow setting stones. Typical ranges of values for compressive strength for commercial plasters and "stones" in use in Australia are:

Range of Compressive Strengths (lb per sq. inch) of 1 inch and ½ inch cubes tested 1 day after mixing

	BEFORE VULCANIZATION	ON REACHING 170°C	AFTER 15 MINS. AT 170°C	AFTER 1½ HRS. AT 170°C
Hydrocal "stones"	3000–6000	700–2000	600–1400	400–1000
Plaster of Paris	1200–2400	250–1000	200–900	nil–650
Anhydrite "stone"	4000–5800	nil–100	nil–50	nil

3 different samples of 1 brand tested.

3. Compression tests made *in* vulcanizer generally give results little different from those obtained on specimens heated under similar conditions but tested *outside* vulcanizer immediately after rapid outlet of steam. 4. Excessive weakening of plaster investments during normal vulcanizing treatments is generally attributable to presence of "slow setting" or "dead burnt" anhydrite ($CaSO_4$) in original plaster of Paris. Even as little as 8 to 10 per cent may have a serious effect. Slow setting anhydrite appears to be slightly more potent in this regard that the dead burnt or non-setting form. Plasters with 14–20 per cent anhydrite

often become as soft as butter after less than 1 hour in superheated steam at 170°C. These plasters sometimes exhibit marked expansion as well. When tested without hindrance to swelling, volume increases up to 70 per cent have been measured after heating for 1¼ hours at 170°C (100 lb. per sq. inch steam pressure). Strongest plasters and artificial stones exhibit less than 2 per cent increase in volume under similar conditions. 5. Disadvantages associated with the use of high strength vulcanizing investments (such as difficulty of removing dentures from flasks or investment from vulcanite, and greater likelihood of crevice formation between artificial teeth and vulcanite) can generally be minimized or entirely overcome by use of suitable separating films (tin foil, cellophane, cellulose triacetate, etc.), between vulcanite and investment.

119. COMPARISON OF ORAL AND VAGINAL SMEARS IN WOMEN WITH CERTAIN GYNECOLOGICAL DISORDERS. *Daniel E. Ziskin, D.D.S., Paul Kamen, A.B., D.D.S., and Irving Kittay, D.D.S., School of Dental and Oral Surgery, Columbia University, New York City, N. Y.* Oral smears were obtained by gently scraping the mucosa with small steel spatula. Areas examined: upper anterior alveolar gingivae; cheek opposite upper molars; and palate. Vaginal smears obtained by suction apparatus consisting of pipette and attached rubber bulb. Vaginal and oral smears were spread on same slide and immediately immersed in Papanicolaou's fixative (50 per cent ether, 50 per cent absolute alcohol). Staining methods tried: Papanicolaou; Shorr original; Shorr modified; Masson's trichrome; Ernst-Gram. Original Shorr stain found best for vaginal smears; Ernst-Gram most efficient in oral smears. With these stains, optimum differentiation on the basis of degree of keratinization was made. With Ernst-Gram, 7 cell types were found, ranging from unkeratinized cells to completely anucleated cornified cells with fragmented cytoplasm. The Shorr method differentiates degrees of cornification of desquamated cells in vagina comparably. Women from sterility clinic, with various gynecological disorders, comprised subjects for study. Smears were evaluated by means of an arbitrary keratinization scale ranging from 0 to 4 plus. Comparison of oral and vaginal smears in this way showed general uniformity in degree of keratinization between vaginal mucosa and alveolar gingivae.

120. CLINICAL AND HISTOPATHOLOGICAL STUDY OF CHRONIC DESQUAMATIVE GINGIVITIS AND ITS TREATMENT WITH THE SEX HORMONES. *Daniel E. Ziskin, D.D.S., and Edward V. Zegarelli, A.B., D.D.S., School of Dental and Oral Surgery, Columbia University, New York City. Clinical:* 8 females, 2 males, aged 21 to 55. Complaints: intermittent burning pain and soreness; associated with menstrual cycle in some. Etiology unknown; hypothyroidism appeared frequently but not invariably. Three main varieties observed: 1. atrophic—loss of epithelium by pressure of inflammatory exudate and edema in corium; 2. true desquamative—stripping of epithelium in layers; 3. vesicular—formation and rupture of vesicles. Lesions on gingivae, palate and edentulous areas; raw, beefy red, bleed easily. *Microscopic:* (all 3 types). *Epithelium:* actively degenerative; loss of epithelial pattern; blunting, flattening or complete loss of epithelial pegs; intra and intercellular edema; disintegration of intercellular bridges;

invasion by inflammatory exudate obscuring epithelium. *Corium:* swollen; edematous; dense accumulations of inflammatory cells; vascularity increased; denuded of epithelium in areas. *Vesicular:* characterized by vesicles within epithelium or beneath it. Vesicles contain bacteria in fluid. *Treatment:* Topical applications of sex hormones according to sex. Concentrated treatment 3 to 5 applications hormone ointment per week, for 2 to 3 months, each application containing 3000 to 4000 rat units. Considerable quantity is lost so that actual amount absorbed is small. Treatment continued intermittently thereafter. *Results:* All benefited. True desquamative type responds best; vesicular type most resistant. Several cases were definitely controlled by this method.

XII. Necrology

A. Isaacs, p. 342; J. A. Marshall, p. 342; A. J. McDonagh, p. 343; J. D. White, p. 344

Aaron Isaacs: 1891–1937

Aaron Isaacs was born in Sacramento, California. He was educated in the public schools of that state graduating from the University of California with the degree of Bachelor of Science in 1913. In this same year he joined the staff of the National Bureau of Standards as Laboratory Assistant in Chemistry.

Recognition of his ability as an analytical chemist came in the form of promotions culminating in the position of Associate Scientist. In 1934 he left the National Bureau of Standards to accept the important position of research chemist with the L. D. Caulk Co., Milford, Delaware, a position he held at the time of his death in 1937. He was married and is survived by his widow, two daughters and a son, the latter, following in the footsteps of his father is serving as a chemist at the Edgewood Arsenal.

He was an expert in the chemical reagent field and in analytical and purification methods for precious metals. He made contributions to dental research along these lines, and especially in developing methods for the analysis of dental cements. His procedure for the evaluation of the tarnish resistance of dental gold alloys is recognized as one of the best. He was elected to membership in this Association in 1932 and was one of the early members of the Washington Section.

John Albert Marshall: 1884–1941

John A. Marshall was born in Chicago, Ill., where his early life was spent. Transplanted with his family to California he took an undergraduate course at the University of California and received a B.S. degree in Chemistry in 1907, although he was only a little less proficient in music. He was a laboratory assistant in chemistry and assistant in music for the first year after graduation. In 1909 and 1910 he studied chemistry at the University of Berlin and spent time both before and after this graduate study in the manufacture of explosives. In 1913 he began the dental course at the University of California, finished in 1916 and immediately thereafter began what was to be his life work, teaching and research in the field of biological chemistry and touching phases of biology. He advanced rapidly and became Professor of Biological Chemistry at the University of California in 1926.

Most of his work was included in nutrition, bone pathology, focal infection, dental caries and studies of pulpless teeth, although these subjects by no means cover all the phases of his activity and do not indicate his great interest in professional education. Between the years of 1921 and 1932 the Dental Index of Periodical Literature lists 54 items under his name with the distribution fairly even except for a slight peak in the 1927–'29 period. In 1926 he published a book on diseases of the teeth and their treatment. He was selected as one of the original members of the Council on Therapeutics of the American Dental Association and continued in that work up to the day of his death. To this work he brought excellent training, a fine back ground of experience and research, and great enthusiasm. He was a very useful member of the Council. During the World War I, he served as a Captain in the Ordnance Department.

He was one of the original members of the San Francisco Section of the International Association for Dental Research and from time to time served his section as both editor and councillor.

ANDREW J. McDONAGH: 1867–1942

Andrew J. McDonagh was a member of the group that organized the Toronto Section of this Association, he was its first Councillor and at the time of his death was both councillor and editor for his Section. He was active and influential in the affairs of his own section, and attended faithfully to his duties as the representative of Toronto in the Council and on the Board of Editors although he rarely attended the general meetings of the Association. He was deeply interested in dental research and its promotion. He was chairman of the Research Committee of the Canadian Dental Association and instrumental in the establishment of a department of Dental Research in the University of Toronto.

He had a wide and noteworthy reputation as a teacher, clinician and practitioner in the field of dentistry. His great mechanical aptitude illuminated his teaching and clinical demonstrations and also found expression in the design and construction of instruments and apparatus. His first contact with the practice of dentistry was obtained in the office of a worthy and inspiring practitioner where he received his instruction. He was later licensed, after a period of study, by the Royal College of Dental Surgeons where in the course of time he became Professor of Crown and Bridge Prosthesis and later Professor of Periodontology. He was influential in bringing his alma mater into the fold of the University of Toronto and served for a long period in the Senate of that institution. He was one of the founders and a past president of the American Academy of Periodontology and a chairman of its committee on research and nomenclature. He practiced his profession in Toronto for more than 50 years.

He was born in Lanark Co., Ontario, was educated and spent his life in that province. He had many interests outside of dentistry, including such sports as bowling and golf, and participation in the activities of civic, service and church organizations. He was a devoted family man and is survived by a widow and children to whom is extended the deepest sympathy of the members of this Association.

JESSE DUNCAN WHITE: 1873–1941

Born in Raymond, Illinois, Dr. White received his early education in the public schools of Litchfield and started his dental training at the Indiana Dental College of Indianapolis but transferred to the Missouri Dental College for a second year's work. He started the practice of dentistry at Illiopolis, Illinois in 1894 and left this to complete his dental education at Washington University from which he received his dental degree in 1901. He practiced dentistry in Springfield, Illinois until in 1904 he was called to the school to the prosthetic department, in which he served continuously with outstanding success until 1936 having early attained the rank of professor. In token of this devoted service the alumni of the school in 1937 placed a bronze plaque in a corridor of the school. During the year 1932–1933 he served as acting dean.

He was not only a skillful practitioner and a splendid teacher, but very active in the work of organized dentistry. He was a past president of both the St. Louis and Missouri State Dental Societies, a charter member of both Omicron Kappa Upsilon and the American College of Dentists. He was in constant demand as a lecturer and clinician.

He joined the Research Association the year after the founding of the St. Louis Section, 1932, and was a highly esteemed member of the group because of his fine character, his love of good companionship and his very high professional attainments.

XIII. Executive Proceedings

A. Report of the Secretary-Treasurer

The Council voted to authorize selection of the Commodore Hotel, New York, N. Y. for the site of the Twentieth General Meeting, and the date March 14 and 15, 1942. This was largely a formality since the Executive Committee of the American Association of Dental Schools had previously chosen that location. The resignation of M. W. McCrea from the Publication Committee was accepted early in the Association year and Dr. J. Frank Hall authorized to act as Circulation Manager until Dr. McCrea's successor could be elected. Under the date of November 26, 1941, the election by the Council of Dr. S. S. Arnim of Richmond, Virginia to fill Dr. McCrea's unexpired term as member of the Publication Committee was announced. No objection being offered thereupon he assumed the duties of Circulation Manager as provided in the By-laws. Under the date of July 15, 1941, the Council authorized the establishment of a new section at Indianapolis.

Death has removed three members during the current year. John A. Marshall of San Francisco, J. D. White of St. Louis and A. J. McDonagh of Toronto. Raymond Gettinger of New York, R. W. Leigh of Washington, D. C., Benjamin Tishler of Boston, Ruth Tunnicliff of Chicago and E. H. Mauk of San Francisco have resigned. The names of Samuel Greenberg of New York, Walter Bridge and James C. Healy of Boston, and F. C. Cadham of Winnipeg have been dropped from the rolls of their sections according to reports from the respective section secretaries.

As of March 4th, 1942, $423 for dues had been collected since the date of the last report, and at this time there is due $146. Cash on hand in the Evanston and Trust and Savings Bank is $936.13 of which $622.65 is in the general fund and $313.48 in the Dental Science and Dental Art Grant-in-aid Fund.

E. H. HATTON, *Secretary-Treasurer*

B. COUNCIL ACTIVITIES AND EXECUTIVE SESSIONS

In addition to items listed above the Council:

1. Voted that all routine notices for the Councillors should be sent to *honorary members* of the Council to keep such members informed of the activities of the Council: but that honorary members should vote only on matters of policy and should not be eligible to vote on matters of personnel and procedure within the scope of established policies.

2. Selected candidates for inclusion in the printed ballot-form.

3. Canvassed and approved nominations for membership as listed on page 349 of this report.

4. Received reports of the active officers and recommended their approval.

Minutes of Executive Sessions:

1. At the opening session, March 14, (a) approved the minutes of the nineteenth general session, (b) opened the ballot box for annual election of officers and approved appointment of H. J. Leonard and William Lefkowitz as tellers, (c) received the reports of the officers and council and ordered their approval, and (d) received the report of the Necrology Committee as printed on page 342 of this report.

2. At the second session, March 14th received the reports of the members of the Publication Committee (page 346) and ordered their approval.

3. At the third session, limited to members of the American Division received the reports of the representatives of the Association to the American Association for the Advancement of Science and elected the representatives for the coming year.

4. At the fourth session received the report of the tellers indicating the election of active officers for the year 1942–1943 as listed on page 349 of this report, and heard the reports of the auditors.

5. At the concluding executive session, (a) received and approved the report of the Endowment Committee for the Journal of Dental Research, (b) installed the active officers for the year 1942–1943, (c) authorized the Council to transact all ad interim business, especially to select the time and place for the next general meeting, (d) approved a dues assessment of $1.00 per member of the American Division only for the year 1942–1943, (e) approved request of secretary-treasurer for authority to draw from the Association's funds to meet current expenses for postage, stationery, meeting expenses, printing proceedings and for purchase of minor office supplies for 1942–1943 year, (f) voted thanks and appreciation for the members of the local arrangements committee, staffs of the Commodore Hotel and the Columbia University Club, the young ladies at the registration desk and *especially those essayists* who voluntarily withdrew

their items from the oral program in order to promote adequate discussion, and (g) elected to memberships the list of names approved by the Council and recommended by them as printed on page 349 of this report.

EDWARD H. HATTON, *Secretary-Treasurer*

C. REPORT OF THE BOARD OF EDITORS AND PUBLICATION COMMITTEE OF THE JOURNAL

The number of pages in Volume 20 was increased to 684 with 62 published papers, the largest volume since 1932. At the same time the number of paid subscribers increased by 40% since 1940 to 1079. Continued support from the subscribers will make it possible to increase the number of pages in the present volume to more than 700 pages. Since the entire income from the JOURNAL is used solely for publication expenses it is evident that as the number of subscribers increases the number of papers published can be increased. The editorial board wishes it brought to the attention of the membership that the JOURNAL receives no income, as yet, from the William J. Gies Endowment for Journal of Dental Research. These funds are in the hands of the Trustees of that Fund and until such time as it may become productive even the costs of life subscriptions are not drawn from that Fund.

It was moved by Dr. Spangenburg and seconded by Dr. Appleton that the Board of Editors express their appreciation of the work of the Publication Committee in advancing the Journal of Dental Research and in so doing advancing the cause of dental research and science as a whole.

The Publication Committee wishes to call the attention of the members to the fact that the JOURNAL is their journal and their efforts in increasing circulation will make possible prompt publication of a greater volume of valuable material.

The cost of publication of the 1941 volume and the income for 1941 were as follows:

Cost of Publication	$5610.29
Printing	4408.20
Stationery	323.88
Postage	152.50
Clerical, office supplies and exhibit	725.71
Income	$5810.55
Subscribers	4580.75
Extra copies	165.80
Advertising	800.00
Extra Illustrations	264.00

D. JOURNAL OF DENTAL RESEARCH, COMMITTEE ON ENDOWMENT

WILLIAM J. GIES ENDOWMENT FUND

Financial Statement as of March 14, 1942

Balance, as per report of March 10, 1941*	$26,362.88

* This is an abridged copy of the report and lists only receipts for the past year and the balances on hand at the beginning and close of the year. Report of March 10, 1941 appeared in the *J. D. Res.* 20: 295, 1941.

	Pledge	*Amt. previously paid*	*Paid in 1941–42*	*Unpaid Balance*	
In Memoriam: John and Ophelia Gies, Reisterstown, Maryland, 1872	1,000	300	500	200	500.00
James B. Man Study Club	1,000	100		900	
L. M. Waugh	1,000	800	200		200.00
Geo. C. Paffenbarger	250	125		125	
Harry Kaplan	250	50	50	150	50.00
1st Dist. Dent. Socty. Kansas	100	20	5	75	5.00
Ohio St. Dent. Soc. Yrly. int.	2,000	60			
Alpha Omega Fraternity $25 yr.		125	25		25.00
Herman F. Bernstein	100	50	50		50.00
Queens Dist. Dent. Socty. N. Y.	100	75	25		25.00
Am. College of Dentists	5,000	3,000	1,000	1,000	1,000.00
Illinois State Dent. Socty	1,500	900	300	300	300.00
Michigan State Dent. Socty	500	250		250	
Gordon L. Teall	10	5		5	
Bethany Meth. Hosp. Coupons		6.75	2.25	27	2.25

John W. Richmond	100.00
W. W. Wickham	100.00
Am. Coll. Dentists, N. E. Section	100.00
R. E. Olson	90.00
Paul V. Reid	4.00
James B. Davidson	5.00
Raymond Hand	5.00
George W. Thompson	2.00
I. B. Bendes	5.00
A. R. Adams	5.00
Wilson P. Eaton	10.00
Harry A. Mesjian	10.00
John H. Gunter	2.00
A. H. Puls	5.00
George F. Peachey	10.00
J. K. Miller	5.00
R. H. D. Swing	25.00
N. J. Leidy	5.00
Thomas P. Fox	5.00
J. C. Curry	5.00
T. D. Casto	5.00
LeRoy Hodge	1.00
Stanley Flickinger	1.00
L. M. Fleisch	1.00
A. J. Buff	1.00
H. D. Wilson	1.00
West Virginia State Dental Society	100.00
Ferdinand Griess	1.00
G. A. Grubb	10.00
Schuylkill County Dental Society	25.00
G. E. Groth	5.00
S. D. Langer	5.00
L. E. Hess	2.00
F. G. Cooper	5.00

M. M. De Van	10.00
A. C. Eglin	3.00
W. P. Manning	5.00
E. R. Strayer	5.00
G. P. Dey	5.00
W. J. Robinson	5.00
A. Ross Crane	5.00
M. K. G. Robinson	5.00
V. H. Frank	5.00
Vermont State Dental Society	100.00
Alex Chase	25.00
W. H. G. Logan	126.10
Charles N. Fiero—25 $1.00 contributions	25.00
Texas State Dental Society	16.00
Maurice Markowitz	1.00
Arthur S. Litten	25.00
W. H. G. Logan	50.00
Bertha Eastwood	4.00
Wisconsin State Dental Society	20.00
Frances Krasnow	25.00
Louis C. Ball	5.00
Arthur H. Merritt	65.00
W. W. Tracy	10.00
In Memory of Dr. M. Tracy (from Mrs. Tracy)	25.00
Edmund Applebaum	5.00
Charles F. Bodecker	10.00
Carl Breitner	3.00
George W. Clapp	10.00
James M. Dunning	3.00
Meyer Klatsky	5.00
J. Oppie McCall	10.00
Edith Oblatt	5.00
Joseph Schroff	10.00
Lackawanna County District Dental Society	30.00
3rd District Dental Society of Pennsylvania	25.00
Hazelton Dental Society	15.00
Arthur Litten	25.00
Lycoming Dental Society	14.00
Samuel B. Black	2.00
Zachary Blum	1.00
W. Cogan	5.00
Isidore Teich	5.00
A. David Horowitz	5.00
5th District Dental Society of Kansas	5.00
W. G. Chambers	5.00
Samuel S. Eisner	10.00
A. C. Rodgers	5.00
Simon Shapiro	5.00
H. M. Seldin	10.00
Abraham Lees	5.00
Louis Abelson	5.00
Harry Reisman	5.00
Jacob Schneer	10.00
Midtown Dental Society	25.00

*Pittsburgh Section—Check from Dr. E. G. Meisel representing a contribution of $20 from each of the following: John S. Ashbrook, W. Harry Archer, Roy E. Black, C. O. Booth, T. W. Brand, H. K. Cooper, W. L. Fickes, J. C. G. Fitz-Hugh, F. C. Friesell, H. E. Friesell, C. W. Hagan, C. S. Harkins, Walter E. Lotz, T. F. McBride, W. A. McCready, P. V. McParland, E. G. Meisel, H. C. Metz, J. S. Oartel, B. P. Rial, W. F. Swanson, L. E. VanKirk, Albert Wise, W. H. Wright, A. C. Young, Robert Zugsmith	500.00
Total Contributions	$30,529.23
Total transferred to savings banks and disbursements	20,513.53
Balance in Empire Trust Company	$10,015.70

3/14/42 Total Deposits in savings banks, $21,040.73, as follows:

Date Deposited	*Excelsior Savings Bank*	*Empire City Savings Bank*	*American Savings Bank*	*Total Interest from 4/1/41 to 1/1/42*
3/11/40	$2000	$3500	$5000	
6/19/40	1000	1000	1000	
9/28/40	1000	500	1500	
12/20/40	1000	500	1000	
6/28/41	1000	500		
Int. to 1/41	46.81	69.38	89.59	
Int. to 1/42	111.82	92.59	129.54	$333.95
Total	$6159.63	$6161.97	$8719.13	

Amount Solicited	$50,000.00
Receipts, pledges and interest on Fund's deposits in savings banks	34,229.13
Balance to be raised	$15,770.87

Respectfully submitted,

L. M. WAUGH
Treasurer

The Treasurer wishes to report further that at the time of the Annual Meeting the Trustees voted to invest the funds in War Savings Bonds. This action was approved by a majority vote of the American Sections.

The funds were, therefore, withdrawn from the savings banks and invested in forty "G" bonds of $1,000 each. There is also a balance in the active account in the Empire Trust Company, 580 Fifth Avenue, New York, N. Y.

E. OFFICERS AND MEMBERS ELECTED

1. ACTIVE OFFICERS: President—*Charles F. Bodecker*, Columbia University, New York. President-elect—*Philip Jay*, University of Michigan, Ann Arbor. Vice-president—*H. Trendley Dean*, National Institute of Health, Bethesda, Md. Secretary-Treasurer—*Edward H. Hatton*, Northwestern University, Chicago. Trustee—*Thomas J. Hill*, Western Reserve University, Cleveland.

2. MEMBERS ELECTED: Andover, Mass.—*John C. Brown*. Ann Arbor—*Donald W. Ker* and *Leslie F. Rittershofer* of the University of Michigan. Asheville, N. C.—*James A. Sinclair*. Austin, Texas—*Edward Taylor*, Department of Health. Bethesda, Md.—*Ralph W. Taylor*, Lieut. Commander, Naval Dental School. Boston—*Irving Glickman*, Tufts College; *Charles M. Waldo*,

* Check of $500.00 from Dr. E. G. Meisel for the Pittsburgh Section was sent prior to March 10, 1942 and was evidently lost in transit. A second check for the amount was received after the annual report was presented. It is included herewith.

Harvard University; *Laurence G. Wesson*, Forsyth Infirmary. Buenos Aires, Argentina—*Jorge Erausquinn*. Capetown, S. Africa—*J. T. Irving*. Chicago—*Philip Burwasser*, Zoller Memorial Dental Clinic; *Fred Herzberg* (Captain, U. S. A.), *Maury Massler*, *Bernard G. Sarnat*, and *John R. Thompson* of the University of Illinois; *Donald W. Wallace*, A. D. A. Laboratory. Cleveland—*A. H. Kniessner* and *W. L. Wylie* of Western Reserve University; *Arvin W. Mann*. Hollywood, Cal.—*Albin Oppenheim*. Indianapolis—*William F. Koss* and *Ralph W. Phillips* of the University of Indiana. Iowa City—*John C. Brauer*, University of Iowa. Kansas City—*Ralph Edwards*, Kansas City Western Dental School. Lincoln—*B. L. Hopper*, University of Nebraska. Memphis—*E. A. Jasper*, University of Tennessee. Nashville, Tenn.—*Oren A. Oliver*. New Orleans, La.—*Harold W. Peterson*, Loyola University. New York—*Ben Seidler*, New York University. Pasadena, Cal.—*Spencer R. Atkinson*. Philadelphia—*Arthur B. Gabel*, University of Pennsylvania. Richmond—*A. Hubert Fee* and *Ralph A. Logan* of the Medical College of Virginia. Rochester, N. Y.—*James T. Ginn* and *H. B. McCauley* of the University of Rochester. Springfield, Ill.—*Charles F. Deatherage*, Department of Health. Total, 37.

F. MEMBERS VOTING AT ANNUAL ELECTION

Aisenberg, Anderson (Bert), Appleton, Archer, Arnold, Austin, Baker (L. W.), Bauer, Bear, Becks, Beube, Bibby, Bier, Boulger, Brodie, Brandhorst, Brashear, Brown (R. K.), Bryan, Bunting, Burkett, Cahn, Carr, Cheyne, Clough, Collins, Cowling, Coy, Crane, Crawford, Darlington, Deakins, Dean, Dobbs, Easlik, East, Ehrich, Elliott (F. C.), Elliott (Mark), Ennis, Epstein (Sidney), Erickson, Figg, Finn, Fleming, Fox, Friesell (H. E.), Gafafer, Gardner, Gies, Goldman, Goodsell, Gordon, Grossman, Hall, Hammond, Hartley, Hatton, Hellman, Higley, Hidnert, Hill, Hodge, Hoffman, Holliday, Hutchinson, Jump, Kaplan, Kelsey, Keilty, Kingery, Kitchen, Klaffenbach, Kotanyi, Krasnow, Krogh, Lalonde, Lefkowitz, Leonard, Lewis, Lischer, Lowery (P. C.), Lowry (R. A.), Lundquist, Lynch, Manley, Mason, Margolis, McBride, McCall, McCrea, McDonagh, Merkeley, Merritt, Millberry, Miller (S. C.), Miner, Moore (G. R.), Mueller (A. H.), Mueller (Emil), Neuwirth, Newman, Noyes (F. B.), Nylander, Oartel, Oblatt, Orban, Oxner, Paffenbarger, Palmer (C. E.), Peyton, Podolin, Pond, Prinz, Rabkin, Radusch, Robinson (H. B. G.), Rogers, Rudolph, Rule, Rushton, Ryder, Scherer, Schlack, Schour, Shapiro, Shaw, Shell, Siegel, Silberstein, Simmonds, Skillen, Skinner, Sloman, Spector, Speidel, Stafne, Staz, Stephan, Stillman, Sorrin, Sweeney (W. T.), Taber, Taylor (N. O.), Teuscher, Thoma, Thomas (B. O. A.), Thomson, Van Huysen, Volland, Wainwright, Weinmann, Wheeler, Willett, Worman, Worner, Wright, Zander, Ziskin. Total, 159.

G. MEMBERS IN ATTENDANCE AT ONE OR MORE SESSIONS, LISTED BY SECTIONS

Ann Arbor—Bunting, Jay, Moore, Peyton, Ward. *Baltimore*—McCrea, Robinson (J. B.). *Boston*—Bibby, Cushman, Deakins, Leavitt, Miner, Morse (F. W.). *Chicago*—Blayney, Freeman, Hansen, Harrison, Hatton, Hemmens, Jump, Logan, Majerison, Orban, Romnes, Schour, Skinner, Stephan, Teuscher, Weinmann, Zander. *Cleveland*—Dressel, Hill, Taylor (P. B.). *Columbus*—Kitchen, Pettit, Spangenburg. *Houston*—Elliott (F. C.), Kotanyi. *Indianapolis*—Cheyne, Crawford, Speidel. *Iowa City*—Bryan, Easton, Higley. *Louisville*—O'Rourke. *Minnesota*—Lasby, Ray. *New Orleans*—Tiblier. *New York*—Applebaum, Bartels, Berger, Beube, Bevelander, Blum, Breitner, Brodsky, Cahn, Darlington, Diamond, East, Foley, Fox, Gies, Hirschfeld, Holliday, Kaletsky, Karshan, Klatsky, Krasnow, Lefkowitz, Leonard, McCall, Miller (S. C.), Neuwirth, Newman, Rosebury, Salzman, Shapiro, Silvers, Stein, Tanchester, Tenenbaum, Thomas, Waugh, Ziskin. *Phil-*

adelphia—Appleton, Burkett, Churchill, Crowell, Ehrich, Gore, Grossman, Moore (Mary), Rosenthal. *Richmond*—Arnim, Bear, Clough, Coy, Hall. *Rochester*—Finn, Hodge, Simmons, Volker. *San Francisco*—Fleming, Sloman. *St. Louis*—Bauer, Hampp, Lischer, Purcell, Robinson (H. B. G.). *Toronto*—Mason. *Washington*—Arnold, Beall, Dean, Goldberg, Klein, McClure, Paffenbarger, Schlack, Schoonover, Sweeney (W. T.). *Not now members of a section*—Anderson (Bert), Coleman, Gordon, Gottlieb, McClendon, Manley, Midgley, Moore (T. E.), Rabkin. Total, 131.